



The MINING CONGRESS JOURNAL

March 1936

Industry's Musketeers

Why The American Mining Congress? Why ANY association?

There are large numbers of associations all classified as "mining." Why should they exist, and why should the mining man support any or all of them?

The answer is not available in words of one syllable. There is a multiplicity of reasons for the Mining Associations, state and national, but chiefly they exist because they have earned support.

The Associations are the modern "Musketeers" of industry. No matter what the attack from within or without, their slogan has successfully been "one for all, and all for one." For, in the final analysis, it is the cohesiveness of an industry that protects it against its enemies.

There is a place for all legitimate mining associations. The State Association which represents the industries within the state; the National Association representing each branch of industry that combines the best interests of those within that branch, **and**

THE AMERICAN MINING CONGRESS

which brings together ALL BRANCHES in accord upon all problems of mutual and common interest. . . . Which speaks impartially for THE MINING INDUSTRY—NOT for coal, NOT for copper, NOT for iron, NOT for gold and silver, NOT for lead and zinc . . . but copper AND iron AND lead AND zinc AND coal AND gold and silver . . . the **common denominator** for mining problems.

Unless minerals can speak with a united voice upon problems of common origin and application, and speak with authority and without prejudice and partisanship, they cannot command the attention and consideration to which their economic importance entitles them. 25-million persons CAN speak in behalf of minerals. They CAN be heard around the world.

THE AMERICAN MINING CONGRESS is the mouthpiece, the spokesman, for ALL the industry. It is FOR organization, state and national, of each of the interests of the industry. It offers its services to these organizations.

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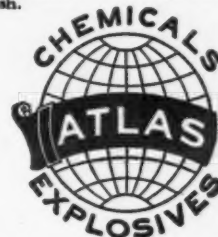
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ATLAS
EXPLOSIVES



MARCH, 1936



The Mining Congress Journal

Volume 22

MARCH, 1936

Number 3

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Briquetting Brown Coal
Modern Explosives
Advancement in Metallurgy
Blower Fans and Tubing in Modern Ventilation

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Wheels of Government
Of All Things
News—Views

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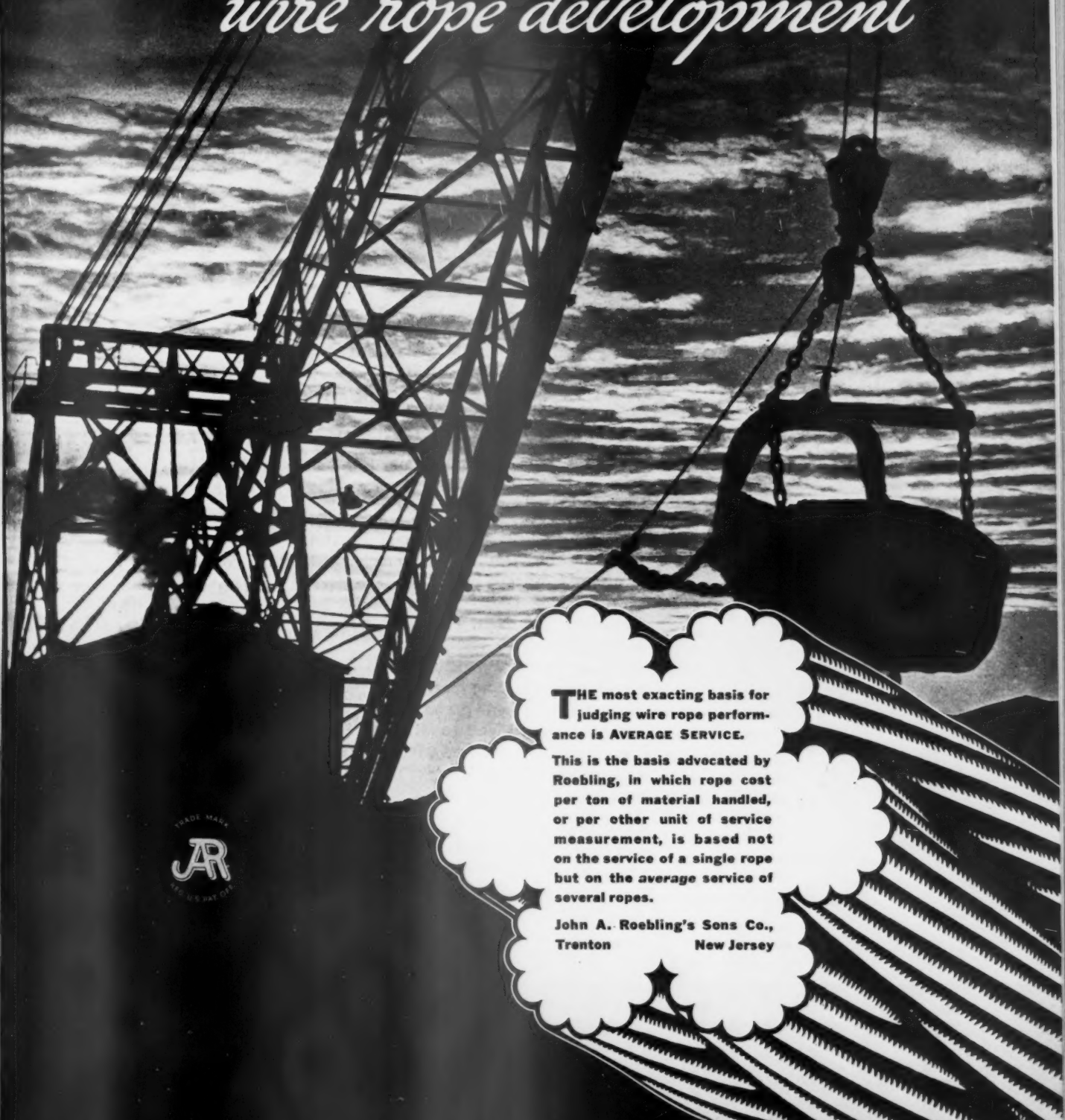
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E. R. COOMBS
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*The pacemaker in
wire rope development*



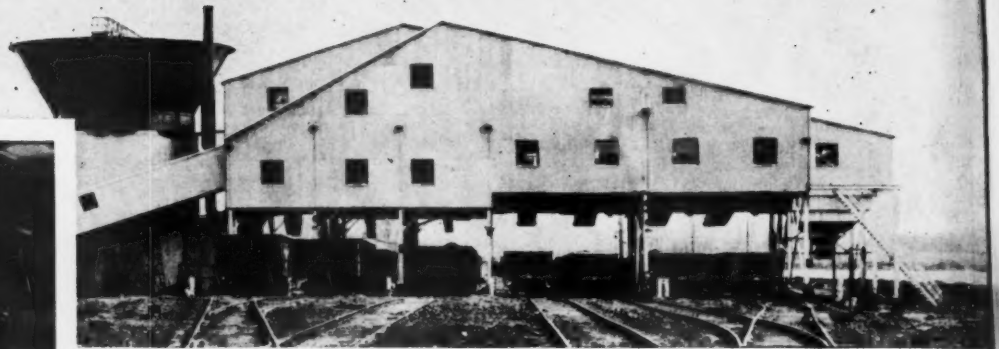
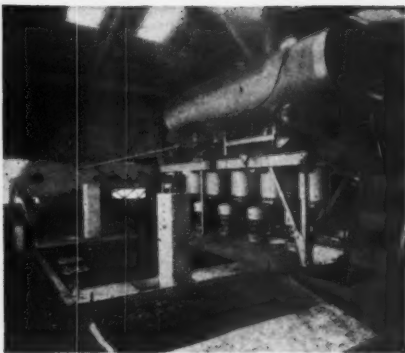
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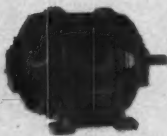


● **NEW HIGH OF 400 TONS PER HOUR**
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An outstanding recent installation of the improved equipment offered by manufacturers of coal cleaning machinery is at the Delta Mining Company's new strip mine in Southern Illinois. Focal point of this great operation is the coal preparation plant, equipped to ship seven primary sizes, and with an over-all capacity of 400 tons per hour.

Readers of Coal Age will recall that "Westinghouse motors are used throughout the plant . . . controlled by Westinghouse 'De-ion' Line-

starters. Westinghouse push-button controls are centered in a panel overlooking the loading booms with emergency buttons at the various units." (Excerpt from Coal Age for May, 1935, page 206 re: Equipment at New Delta Coal Company property near Carrier Mills, Ill.)

When you install modern, cost-saving machinery, specify *complete Westinghouse Drive*. Take advantage of what Westinghouse has learned during 50 years' electrical experience.

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A GOOD MACHINE IS WORTHY OF A GOOD DRIVE —

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ON THE TOUGH JOBS OF HARLAN COUNTY, KY.,

You'll Find **TIMKEN BEARINGS**



HARLAN-WALLINS COAL CORPORATION
INCORPORATED
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January 7th, 1936

Mr. W.B. Moore
Gen. Manager Industrial Div.
Timken Roller Brg. Co.,
Canton, Ohio

Dear Sir:

We have recently placed an order with the Sanford-Day Iron Works for 75 more four ton capacity mine cars Timken equipped.

No doubt you will be interested to know we have definitely proven to our own satisfaction Timken's perform better than other types of bearings in our cars.

The entire operating division of the Harlan-Wallins Coal Corporation voted for Timken when this order was placed. We now have 870 Timken equipped cars in our Marathon, Mokus, Bear Branch, and Darby Mines. Considering the severe service received by the bearings in these various mines, you might know this has made a most favorable impression with us.

Very truly yours,

Pearl Bassham
Pearl Bassham
Vice-President

The HARLAN-WALLINS COAL CORPORATION Puts 75 More Timken Bearing Equipped Mine Cars In Service.

The addition of these new units brings the total number of Timken-equipped cars owned by this progressive operator up to 870.

Read what Mr. Pearl Bassham, Vice President of the Harlan-Wallins Coal Corporation has to say about Timken Bearings in his letter reproduced here.

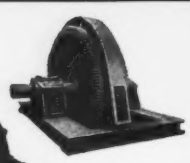
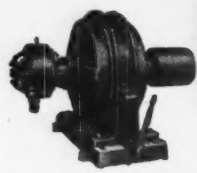
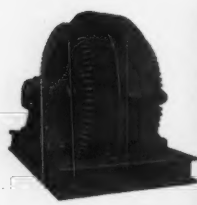
Mr. Bassham—like hundreds of other prominent mine executives—knows that 38 years of manufacturing tapered roller bearings and 15 years of applying them to mine cars is an assurance of performance and satisfaction that no other type of bearing can offer.

There is no substitute for the exclusive combination of Timken tapered construction, Timken positively aligned rolls, Timken Alloy Steel and Timken Mirror Finish.

THE TIMKEN ROLLER BEARING COMPANY, CANTON, OHIO

TIMKEN *TAPERED ROLLER* **BEARINGS**

MARCH, 1936



8 Big Reasons Why It Will Pay You To Select G-E SYNCHRONOUS MOTORS

THE RIGHT SYNCHRONOUS MOTOR FOR EVERY JOB



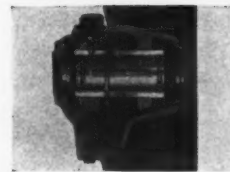
1. A special, high-quality insulation, developed in the G-E Research Laboratory, protects the windings of every G-E synchronous motor against oil, mild chemicals, abrasive materials, etc.—your assurance of long motor life and low maintenance.



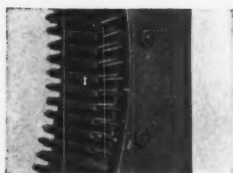
5. Heavily insulated field leads can't become loose, because they're held securely in place by clamping blocks. Wide collector rings with staggered brushes wear longer and more evenly. Result: low maintenance costs.



2. The bars of the starting windings are fitted into tapered holes in the end rings, and silver-soldered at red heat, thereby making permanent alloy joints that are as strong as the parent metals themselves. Result: low-resistance joints that can't become loose.



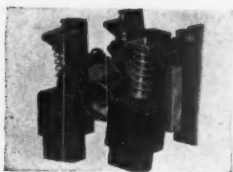
6. Accurately bored sleeve bearings of hard tin babbitt, with large bearing surfaces, give long, dependable service. Long, close housing fits with grease-filled grooves, protecting the bearing against water, dust, grit. Result: long life for bearings.



3. The stator cores of G-E synchronous motors are built up of thin sheets of high-grade silicon steel, each of which is separately annealed and enameled after punching. Result: low core losses and high efficiency.



7. From General Electric's complete line of synchronous motors and control it is easy to select the RIGHT MOTOR and the RIGHT CONTROL for every job—a perfectly matched combination that will promote greater economy in your plant.



4. The one-piece box-type brass brush holders used in G-E synchronous motors apply pressure at the center of the brush in a radial direction, thereby preventing chattering or binding. Result: long brush life.



8. General Electric's 40 years' experience in the design, manufacture, and application of synchronous motors and control is your assurance that this equipment will give years of continuous service. General Electric, Schenectady, New York.

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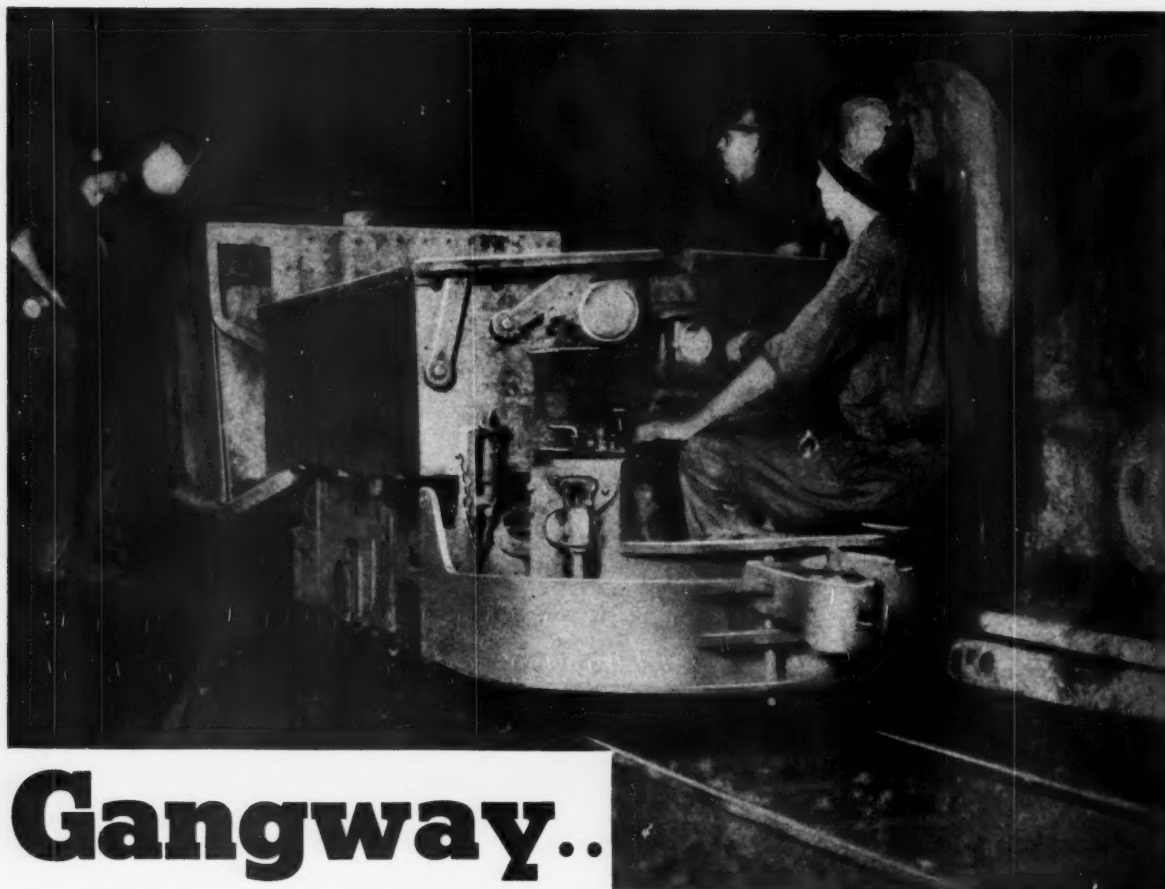
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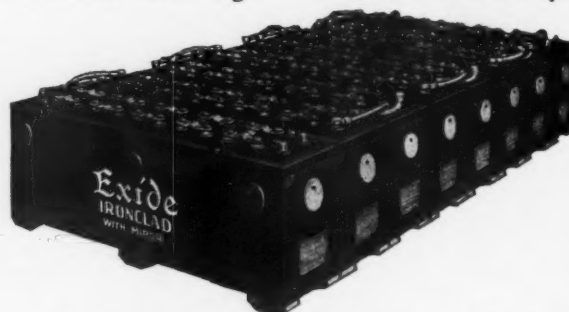
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The Exide-Ironclad Battery differs from all others. In its positive plates, slotted rubber tubes retain the active material while exposing it freely to the electrolyte. Separators are of Exide Mipor—the permanent storage battery plate insulator that is immune to electrolyte, heat and vibration.



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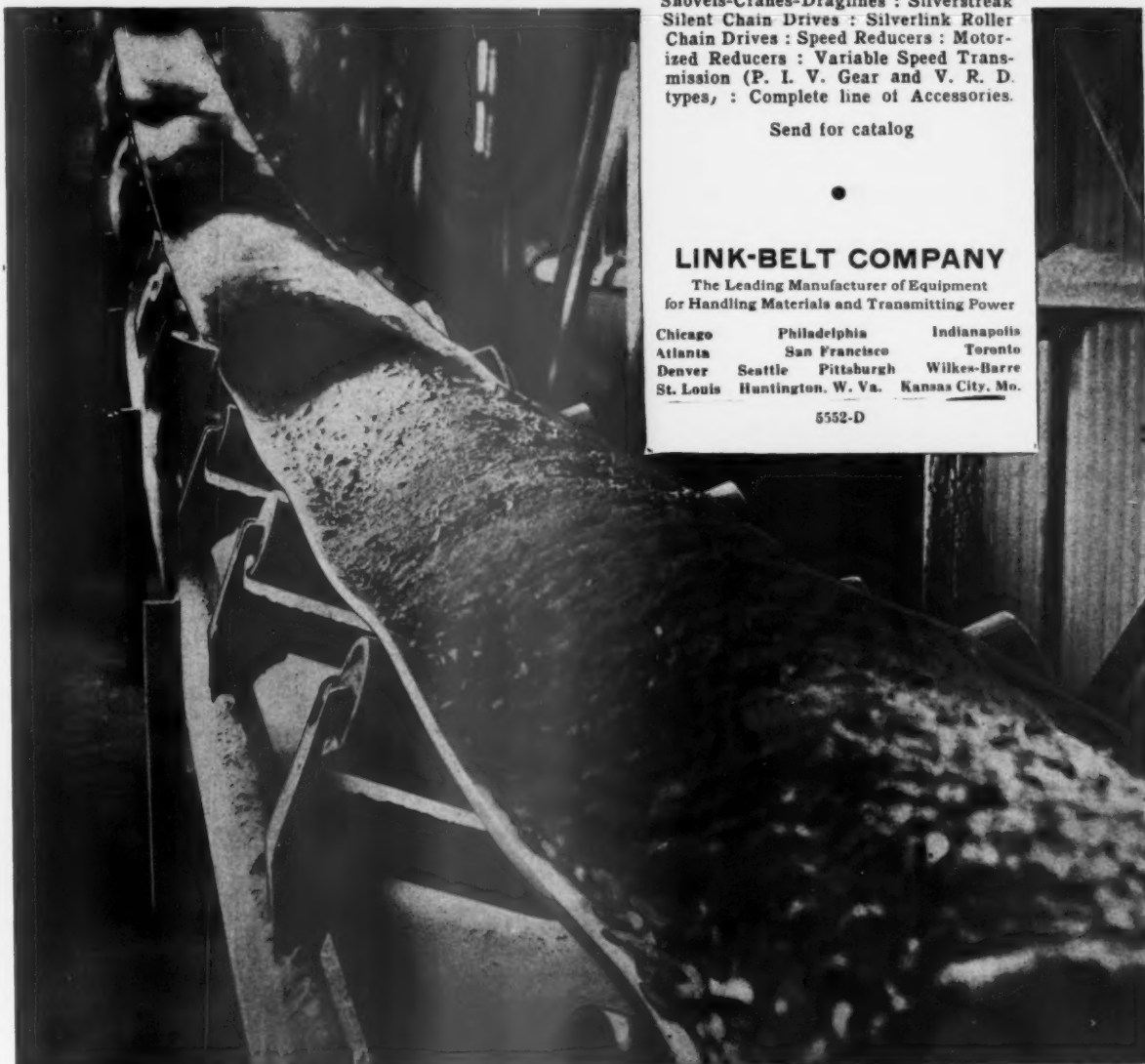
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5552-D



What!

Measure *with a* WEDGE ?



RIGHT you are, a tailor would have a difficult time measuring his cloth with a wedge, but as the basis for measuring the dependability of more complex products, few things can compare with this simple mechanical device. It is just such simple objects as the wedge which serve as a guide and an inspiration to O-B engineers in their efforts to increase constantly the dependability and reliability of O-B products.

That such efforts are successful is evidenced by the remarkable performance records of all O-B products. Records such as 20 years of trouble-free service from hangers and clamps, or the fact that O-B trolley shoes deliver from 4 to 6 times more life than ordinary collectors, mean greater dependability—freedom from worry for the men at the mine and more dollars on the profit side of the ledger for the operator.

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Specify O-B, and you specify Dependability

An Appropriate Penalty

IT is a matter of some consolation, to those who still believe in the rugged honesty of our forefathers, that our national repudiation of gold bond obligations did not set the example but followed the precedent set by World War nations in their wholesale repudiation of agreements to repay the money borrowed from the United States at a time of their dire necessity.

The attainment of the Kaiser's dream of European control was almost a fact when the United States came to the aid of the Allies and saved them from annihilation only to have them repudiate their agreements to repay a small part of the cost to us of their national existence.

In an apparent effort to salvage some part of these losses, Senator Vandenburg, at the Senate Munitions Committee investigation, raised again the question of exercising the option of the United States under war debt agreements to ask defaulting governments to issue marketable bonds covering these debts.

In response, a witness before the committee stated: "When the debts went into default, did not the agreement fall? If so, there is no agreement." This seems to be an entirely new business principle. *That the refusal to live up to an obligation has the effect of cancelling that obligation.*

I am sure that any borrower at any bank would find it difficult to secure approval of that principle as a satisfaction of an overdue bank note.

The direct interest of the mining industry in what may seem to be a world problem lies in the fact that, in case these debts are not paid, the mining industry will be forced to make up its share of the deficit—a sum of more than \$320,000,000.

If the metals manufacturing industries are included, the total is more than two billion dollars.

To the allegation that these debtor nations are unable to pay, it seems a complete answer to point out that these nations are spending for war preparation many times the amount due the United States.

The nations most dangerous to world peace are those who repudiate obligations incurred in past wars.

There has been a strong effort in this country to develop a public opinion, to the effect that insistence on the payment of these European obligations would make it impossible for them to buy our goods, and we would thus lose more in trade profits than we would gain by the collection of these debts.

Under these conditions we are expected to continue to do business with defaulting nations to their great profit; to keep our markets open to their exports, which displaces our own labor; and we are criticized because we do not allow ourselves to be dragged into their international conflicts growing out of the distrust which necessarily follows repudiation.

The United States can produce nearly all of the things needed for our comfort. So far as economically possible, no nation which persists in its repudiation of honest obligations to us should be permitted, directly or indirectly, to sell in our markets.

J. H. Calverath



The Mining Congress Journal



Volume 22

MARCH, 1936

Number 3

E. R. COOMBES, Editor

A Journal for the entire mining industry published by The American Mining Congress

And Still More Taxes

THERE was considerable dissatisfaction over the "Revenue Bill of 1935," the manner in which it was developed, and the far reaching taxes that were its purpose. The 1936 proposals bid fair to outdistance all previous tax measures, for in some manner the Administration must find the revenue to cover the extraordinary costs of government. The passage of the bonus, the declaring of the unconstitutionality of the processing taxes, and the ever mounting unemployment and relief expenditures, bring the Congress face to face with an emergency. It is meeting it in the only way that seems expedient—more taxes. The recent demand upon Congress to raise an additional billion of revenue to take care of these obligations is truly alarming. What chance is there to "balance the budget" and still maintain all the agencies of relief and "emergency?" What hope has the taxpayer of relief from still greater and greater tax burdens? None, unless Congress is firmly informed that expenditures and taxation must be curtailed, not increased. It is up to Mr. Average Citizen to accomplish this task. And as the tax falls upon him, he will not be silent. We anticipate an anvil chorus. Speed the day!

Liberty

OPPORTUNITY for everyone with the ability and energy to grasp it has been an American principle. The story of this country is replete with examples—boys who have started from scratch and made good in a big way. Boys who recognized opportunity when it came their way, and when it did not come, made the opportunity.

The present tendency to break down that spirit is perhaps the most serious problem confronting us. The political dole system, the instilling of the thought that Government not only will but should take care of those citizens who for many reasons fail to take care of themselves, is directly contrary to sound thinking.

It is no idle indictment that socialism, communism, and radical proposals of all sorts have had a mushroom growth in this country during the period of the depression. It was to be expected that certain advocates of these ideas would take full advantage of the discontent, the misery, the suffering brought on by world conditions.

Our forebears were "protestors," just as many thousands of people have been protestors during the past five years. But with their protesting they combined intelli-

gence; they did something about it. They conceived and put into effect a Constitution based upon Liberty Under Law, that has stood the test of time, that has not yet failed us. They did not blindly rant and demand that those who had wealth must share it with them. They did not set up a Bureaucracy, founded upon the fallacious thought that through taxation wealth might be redistributed; they did not borrow to the limit of their capacity, and beyond, passing on a burden of debt to the third and fourth generation.

What these forebears wanted was Liberty and Opportunity. That is what the true American wants today. He can never achieve it by accumulating a load of debt, by replacing individual initiative with Government doles.

It is the duty of every individual to see that Freedom, and Liberty, and wise Government are protected; that those who serve us in the Nation's Capital shall represent the best thought of all the people.

Silicosis

FROM the dawn of history, the people engaged in mining have known of rock dust and of the discomforts which follow when one works in or is exposed to a dust-laden atmosphere over a long period. "Miners' asthma" is not new, nor was it news for the public press and congressional committee hearings until recent sensational and lurid accounts were broadcast over the country.

Our mining managements have worked to solve the dust problems (particularly that of silica dust) for many years, and the work was given renewed impetus with the creation of the United States Bureau of Mines. This work has gone forward with real accomplishment in many of our mining fields, without any blaring of trumpets or waving of banners.

Constructive performance along scientific lines does not lend itself to promotion through blatant, self-seeking publicity. The establishment of well-equipped clinics, the keeping of men with infectious diseases out of the mines, the provision of adequate ventilation, and the enforcement of measures to reduce the dust content of the mine air to a safe level are not matters that make headlines. In coal mining, the wetting down of the faces and the use of water on the cutter bars of mining machines to minimize the dry dust is another example of unostentatious accomplishment.

As a matter of fact there is little, if any, disabling silicosis to be found in mining. A basic difficulty lies in

the victimizing of workers by preying, unscrupulous lawyers. Both management and labor are really on the same side of the problem and are being attacked from without. Naturally labor suffers the greater harm. Frequently men are so influenced by the unscrupulous propaganda on silicosis as to believe that their health is affected, that they are unfit to work and that they will soon die. They are persuaded to perjure themselves by presenting sworn testimony that they are unsound physically. In case the lawyer is able to secure a judgment he is the one who benefits and the worker is left with little money, with a depressed state of mind, with no job and with little chance of securing one.

The excellent work of the past and present by the Bureau of Public Health and the Bureau of Mines must be continued, and the House of Representatives will do much more to aid workmen and management by supplying adequate funds for the valuable studies of these agencies than by devoting public money to further hearings such as recently witnessed in the committee rooms on Capitol Hill.

Facts That Are Important

INTERESTING figures recently have been compiled on the "soak-the-rich" idea. They deserve more publicity. For instance, these figures show that if, during the last five years, every cent of corporation income had been taken by the Government in taxes, and that if, in addition, the Government had taken every cent of individual income in excess of \$5,000, the returns would still have fallen short by \$10,000,000,000 of paying the Federal, State, county and local expenses.

Facts such as these are gradually becoming known, and their reaction is evidenced by a definite swing in sentiment toward sound principles of Government. With increasing momentum party lines are being dissolved by the flagrant and profligate inefficiency in handling public money. We have only to point to such ludicrous yet serious examples as the inefficiency of certain PWA projects, illustrated in one district in the building of a ten-by-ten shelter. This simple task required three supervisors, thirty-three workmen—and one hammer and one saw!

It is highly important that Members of Congress shall be informed of local conditions, and particularly that they shall become aware of the undercurrent of public discontent over ill-advised legislation which has undermined and is undermining our national moral fibre.

Labor In Politics

IN OTHER COUNTRIES labor is frankly organized in political parties. England has had a "Labor Government" and has gone through an interesting period of union domination. But in the United States we have prided ourselves that we have had no class distinction; that the humblest had equal opportunity with the wealthiest; that we were "one people." Labor, as such, has not been a conscious factor, although its vote far outweighed the so-called capital class. With the growth of unionism, with its attendant placing of power in the hands of labor union leaders, a very definite effort has been made toward class-consciousness, until with the recent convention of the United Mine Workers of America, labor frankly entered the political arena.

In previous campaigns labor has been careful not to commit itself to a candidate; but in the present campaign the United Mine Workers have declared

unequivocally for a candidate. This entry into politics in a big way by a national union is a milestone that should not be underestimated. So far neither major political party has nominated its candidate. It is anticipated that Mr. Roosevelt will be the candidate of the Democratic Party, although there are many other possibilities; the Republicans have no one outstanding candidate, and the speculation in this direction is still only speculation. In spite of these facts we have a leading labor union openly pledging millions of votes to a candidate before that candidate's opponent is announced, his platform declared, or his principles outlined.

The United Mine Workers has much for which to thank the present Administration. Under the late unlamented NRA they were able to completely unionize the coal industry; they endorsed and sponsored the Guffey Coal Control Act now before the Supreme Court for decision as to constitutionality; they advocated the Wagner Labor Disputes Act. These explain generally why the United Mine Workers have declared unequivocally for a candidate before the race is announced.

Utopia Unincorporated

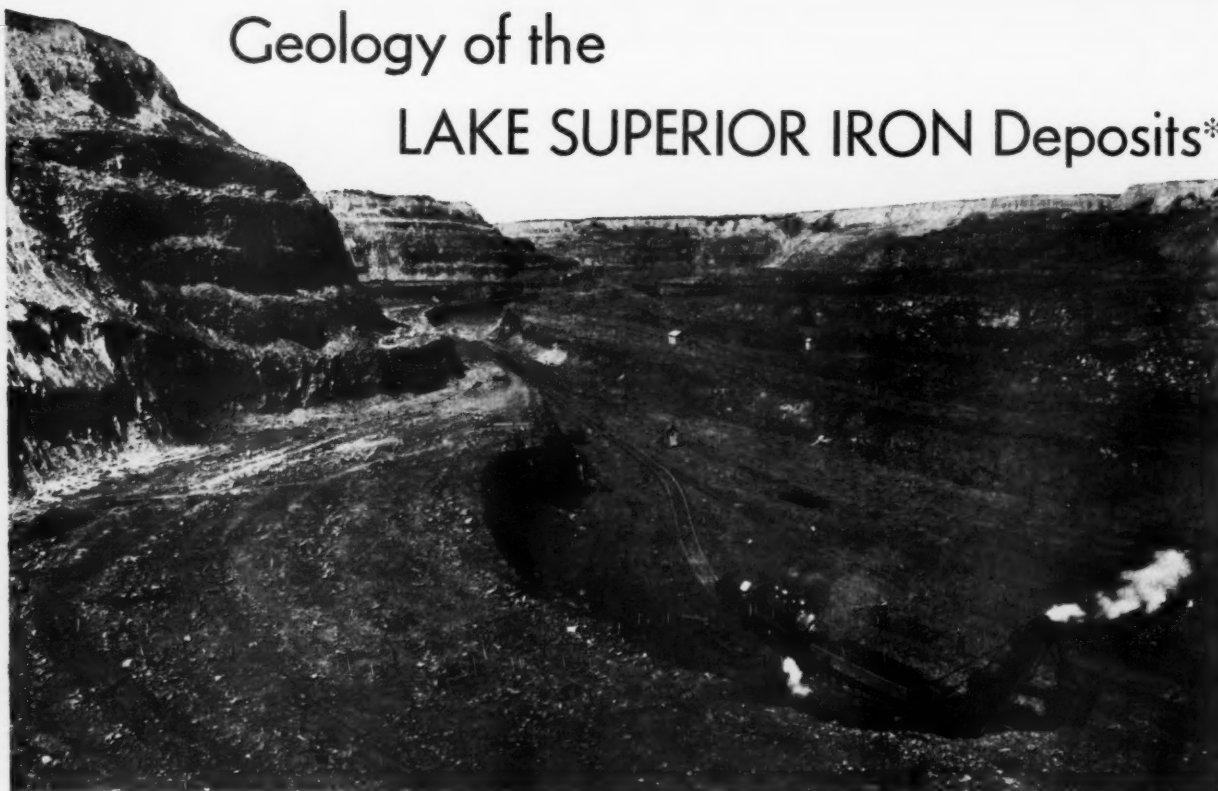
THE DECISION of the Supreme Court on the Tennessee Valley Authority, limited as it was, has given new impetus and life to the zealous group in Congress who are determined to bring Utopia to the United States, regardless. We now have before Congress a proposal for harnessing the Mississippi River in the same manner. This project is being camouflaged as flood control, conservation of natural resources, and other intriguing titles. The major purpose of these proposals, however, is to produce electric power by the Government in competition with the established power companies. The surplus power thus generated is to be sold to the public, and the Government's power generation "costs" are to be used as the yardstick to measure power rates. The Supreme Court's decision centered only upon the right of the Government to sell its surplus power, the fundamental issue of Government's competition with private industry not being involved.

Government competition in business is a familiar phrase. There has always been the threat to industry of Government ownership, dictatorship or confiscation, but never has the threat become such an actuality as in the ambitious power program with its tremendous expenditure of all of the people's money to give cheap power rates to certain sections of the country. The extension of this principle to other lines of industry is not a remote possibility. The situation calls for serious consideration.

To the Credit of Industry

THE DEPARTMENT OF COMMERCE recently said that in the five-year period from 1930 to 1934 industry paid out as income some 26½ billions more than was produced, and that this roughly represents the business losses for this period. That statement graphically illustrates what happens to industry in periods of depression and the competence of business to meet the situation. It also emphasizes the great necessity for industry in times of prosperity to receive a fair return upon investment—plus. Industry is but the individual, grown up. What it saves, what it invests, what it produces, at a profit, demonstrates its competence. Apparently American business can take its bow, for a loss of 26 billions in five years, and still solvent, presupposes business accumen far above the average.

Geology of the LAKE SUPERIOR IRON Deposits*



Spruce Open Pit Mining Operations—August, 1935, "K2," Eveleth, Minn.

THE joint request of the Mining Congress committees for the Minnesota and Michigan sides of the Lake Superior district, as transmitted to the writer, calls for a paper on Lake Superior geology, more particularly in relation to the iron-bearing formations and ore deposits, to be a general view of the Lake Superior iron ranges, summing up the net present opinions regarding them, the major features, discussing the major differences between, and principal characteristics of the ranges and of the ores, with their bearing on the kinds of ore and the methods of production.

The date of the request leaves little time for preparation of the paper and for compression into as brief a scope as may be of a subject which has occupied most of the time of successive generations of geologists for the better part of a century, including some of the greatest names in the roster of geologists both living and dead.

It is with a full acknowledgment of indebtedness to, and a due humility in attempting to tread the trail of, these illustrious predecessors that this paper is offered. The subject has filled many large volumes and there is today a real need for a full and comprehensive current work to be published which shall correlate and harmonize and summarize

By STEPHEN ROYCE†

the labors of all these workers, present and past, into a single picture. To paint this picture in words would be a worthy task for a geological writer combining in literary ability the artistic genius of a Rembrandt, a Michelangelo, and a Da Vinci. To put such a work into a brief compass and in a brief time, requires the spreading on of broad splashes of hastily-mixed or unmixed colors, which at best can give but an impressionistic picture, and which the writer can only hope will not degenerate into a meaningless Cubist daub. The added requirement that the paper be, as far as possible, comprehensible to a non-geological group of mining men adds a further stimulating element of difficulty.

What is here said about the Pre-Cambrian in general was for the most part told, and better told, by Dr. Leith in his presidential address before the Geological Society of America last year. He should be the one to write this paper, and no doubt would be if he were not already presenting larger mineral questions before this congress.

Geologic, Age and Broad Relationships of the Lake Superior Region—The en-

tire group of Lake Superior rocks belongs to the ancient series known as the Pre-Cambrian. In the beginning, geologic history was traced from Cambrian time down, and all the better known geologic formations belong to the Post-Cambrian. For the better understanding of non-geologic readers, the period from the beginning of Cambrian time to the present may be likened in geologic history to the Christian era in human history. There are gaps in human history in the Christian era but they are nowhere as serious or profound as the gaps in Pre-Christian human history. Such gaps as exist are confined to individual localities but can always be bridged by a knowledge of contemporary history in other or neighboring localities. In Pre-Christian history no such continuity of knowledge exists. In isolated places a sketchy knowledge of history extends back to five or six times the age of the Christian era and of course fragmentary evidence exists of human beings living many times farther back than that. But there are vast unbridged gaps both in time and space in Pre-Christian human events as known to us.

A very similar relationship exists in geologic history. From the Cambrian on, the picture is substantially continuous for the world, although wide gaps are found in local areas. In Pre-Cambrian time there are several gaps indicating a vast period of time where no data exist to bridge the gap anywhere in the world. The Pre-Cambrian

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† Mining engineer and geologist, Crystal Falls, Mich.



Part of Missabe Mountain Mine, Virginia, Minn.

rocks have been subjected to enormous and slowly pulsating periods of mountain-building and erosion, in the building of land surfaces which had long vanished from the earth before the first fossil shellfish sank to the ocean floor in Cambrian time. The Pre-Cambrian rocks, however, underlie all of the continental areas at varying depths, which in the areas not affected by Post-Cambrian mountain-building increase to the south in the Northern Hemisphere and to the north in the Southern Hemisphere. They cry their presence to us through the softer and lighter younger rocks through the seismograph and the torsion balance of the oil-seeking geophysical explorer as far south as Texas.

The birth and localization of the greater continental areas seems to have had its origin in Pre-Cambrian time. Possibly Green's tetrahedral earth was shrugging its triple shoulders more or less in unison in early Pre-Cambrian time, producing the great Hudson's Bay shield of North America on whose south margin the Lake Superior region lies, at the same time that it was producing the Scandinavian Pre-Cambrian area of northwestern Europe and a less-known Pre-Cambrian area in eastern Asia, all spaced about 120 degrees of longitude apart around the Northern Hemisphere. At the same time the tetrahedral earth may have been uneasily pushing its pointed feet out in the Antarctic continent.

At any rate, the movements of the known Pre-Cambrian areas seem to have had a surprising unanimity, reflected in a remarkable similarity of type and succession of formations in widely separated quarters of the world. The Pre-

Cambrian, from its enormously longer history and the far greater number of profound geologic changes which have affected it, is more prevailingly crystalline and metamorphic than the later rocks and was for the most part dismissed by early geologists as an undecipherable record representing the ancient primeval crust of the supposed cooling molten globe which was called for by the now little-regarded LaPlace hypothesis.

Much of the study of the Pre-Cambrian by geologists has naturally been focused especially on the economically valuable areas, and branching out from these, has shown that further and further back in the Pre-Cambrian the earth was geologically and meteorologically much what it is today. The present consensus of opinion is that the original crust of the earth, if indeed there was such a crust, has by now been metamorphosed out of all semblance to its original form and may be at no point on the earth exposed, or if so exposed has been so remelted and changed as to be unrecognizable, lost and disintegrated in the granite wilderness of the Laurentian.

Data as to the Pre-Cambrian ages are nowhere helped by fossils as these are almost as non-existent in the Pre-Cambrian as they are ubiquitous in the later rocks. Recent work with the radio-active group of elements originated by the physicists has given us a new tool for determining geologic ages, which apparently offers the only hope of definite matching of ages in the Pre-Cambrian. This work is in its infancy as yet and about all that can be said is that the ages of the known Pre-Cam-

brian formations extend back at least to five or six times the period from the beginning of Cambrian time to now, with every reason to suppose that there is a very much longer period back of that, of which the record has been lost beyond trace by fusion in the depths of the earth.

The radio-active investigation seems to show that the Cambrian began some five hundred million years ago. The earliest Pre-Cambrian sediments known seem to have been on the order of five or six times as ancient as this, and in some of the early Pre-Cambrian sediments there is clear evidence that there were tides, rainfall, winter and summer, and even that prevailing winds were then much what they are now in the same area.

The Pre-Cambrian has passed through a series of events which has resulted in duplicating series of formations in places as widely separated as India and Michigan. Geologists of either area recognize the duplication at once on visiting the other area. Large suites of specimens can be matched in their same order, separated by similar great unconformities, or erosion periods, in the two localities. Whether this duplication represents simultaneous movement and conditions, remains for the radio-active investigation to determine, but there seems to be reason to suppose so.

At any rate, it is to this great Pre-Cambrian series that the entire Lake Superior iron and copper-bearing formations belong.

The Lake Superior Trough—The Lake Superior basin is itself a geo-syncline; that to say, a place where an actual depression in the surface of the globe cor-

responds with a synclinal or trough structure. The rocks of the south shore of Lake Superior reappear on the north shore in Minnesota and Canada in reverse order, the younger rocks being nearest to the lake, and in part in the marginal areas of the Lake; the older rocks being found further north on the north shore and farther south on the south shore. The area including all the Lake Superior iron and copper region lies on the south margin of the great Hudson's Bay Pre-Cambrian shield. At its southern, western and eastern edges the Pre-Cambrian formations are found to pass under a flat-lying blanket of Cambrian and later formations, which increases in depth indefinitely to the south as far as considerations of the present paper are concerned. It is interesting to note that the southern margin of this Pre-Cambrian shield is marked by a water gap most of the way from the Gulf of St. Lawrence to the mouth of the McKenzie River on the Arctic shore.

Whether there is actual physical continuity from the south shore of the lake to the north shore of the lake is not certain. In an ingenious hypothesis to explain the Lake Superior geo-syncline, Hotchkiss has suggested that it is due to the welling up of a great igneous bubble which stressed the overlying beds to the breaking point after which they foundered along the margins of this great intrusion. This igneous intrusion is supposed to have foreshadowed and culminated in the Keweenaw copper-bearing flows. If this suggestion is correct, there would be physical discontinuity and the center of the basin under Lake Superior would be occupied by a great mass of igneous rock. The consensus of opinion has otherwise been, among geologists, that except for some major faulting, there is physical continuity of formations at depth between the south shore and the north shore of the lake.

Geological Sequence and Major Events in the Lake Superior Region.—The oldest known rocks of the Lake Superior region belong to the so-called basement complex, largely granitic, which is called Laurentian in age and which occupies a large, if not major, portion of the Pre-Cambrian shield of North America. Some parts of this basement complex, though the basement complex, though the tremendously metamorphosed, appear to have been sedimentary, and to these has been given the name Keewatin. The relations between the Keewatin and Laurentian

are not clear and are to some extent contradictory, so for present purposes the two may be classed as a single great age constituting all Pre-Huronian time.

On top of this basement complex appear two major subdivisions, the Huronian and Keweenawan. It is in the Huronian rocks that all the iron ranges of the Lake Superior region are located, except the Vermillion range of northern Minnesota and some corresponding but little-productive and discontinuous ranges in Canada. The Vermillion district is by practically all contemporary geologists classed with the Keewatin, although the early geologists viewed this range also as Huronian and the writer inclines toward the earlier view.

On top of the Huronian comes the Keweenawan in which the famous native copper deposits of the Lake Superior region are located. The lower and economically more valuable portion of this series is mainly volcanic with intercalated conglomerate sediments. Its upper portion is a series of conglomerates and shales which by some is believed to be contemporaneous with the bottom of the Cambrian period. Recent radio-active studies seem to give some support for this view, but this question is still wide open.

The three great series, Laurentian-Keewatin, Huronian, and Keweenawan, are separated by wide unconformities marked by conspicuous conglomerates. These unconformities represent unknown but presumably very large lapses of time which have commonly been considered at least as great as the entire period from the Cambrian to the present. It is hoped that the radio-active line of investigation will within a few years provide better knowledge as to the time element

represented in these unconformities. These three great groups of rocks, the Laurentian-Keewatin, the Huronian, and the Keweenawan, are repeated in type in other Pre-Cambrian areas of the world. Whether these duplicate types represent substantially duplicate time periods is still to be found out, but it seems entirely plausible to suppose that they do.

According to Lawson, there are two great granitic intrusion periods represented in the Pre-Cambrian of the world. According to Chamberlin, there are three such intrusions. With proper reservation of definition, the Michigan iron ranges show three such intrusions, although the third is only locally granitoid in nature and is in the main a gabbro.

The oldest of these granitic intrusions and by far the greatest is the Laurentian granite. A granite in essence and in definition is a deep-seated intrusive rock. The marginal or country rocks into which the Laurentian granite of the Hudson Bay shield intruded are unknown or little known. This intrusion represents possibly the largest known batholith, or mass of granite, in the world. It contributes major conglomerates marked by huge granite boulders and pebbles to the base of nearly all sedimentary rocks with which it is found in contact. Its contacts with the Keewatin are little-exposed and obscure where found. The Laurentian granite is intruded by igneous rocks representing every subsequent known period of igneous action.

The later periods of granitic intrusion are variously described under local names in the different districts in Canada and the United States, and the relationships of the various occurrences to one another are often obscure. For the purposes of the present paper these relationships and names will be restricted to those of the Michigan, Wisconsin, and Minnesota ranges, where the relationships are best known.

The second period of granitic intrusion is clearly shown in Michigan. A similar granite later than Laurentian is known in Minnesota but is classed there as Lower Huronian though the writer believes it will be ultimately proved to be contemporaneous with the second granite of Michigan which is Upper Huronian. The eastern Gogebic has a granite footwall which in the early days of the development of the range was thought to be Laurentian like that which in the central portion of the range is known to be Laurentian. Work of Allen and Barrett about 1911 showed that north of Marquette and west of Gogebic Lake this granite intrudes across and metamorphoses the entire Huronian series, and similar relationships of a great granite mass were identified on the Menominee Range in the Florence district of Wisconsin and along the boundary of Dickinson and Iron Counties near Randville, Mich., as early as the 70's by the elder Chamberlin, Rominger and



Dead River bridge on L. S. & I. R. R. The track is 135 feet above the water. This bridge, originally supported on two columns, was too light to safely carry the heavy Consolidation type locomotives built in 1916. Hence the arch was added increasing the loading from Coopers E-40 to E-60.

others. This granite is definitely older than the Keweenaw which it does not intrude and with which it has no connection. The second granite therefore is of late Upper Huronian age. It is called the Presquele granite on the eastern Gogebic and this has been correlated in turn with the later intrusive granite of the Menominee Range, and with the Wolf Lake granite which metamorphoses the Huronian rocks south and southeast of the Gogebic Range and west of the Menominee Range.

The two granites so far described are true granites. The ancient Laurentian granite is composed largely of white feldspars, prevailingly orthoclase, with much clear glassy quartz and moderate amounts of mica, both muscovite and biotite. The Laurentian granite has been in many cases partially remelted; the original crystalline outlines of the feldspars have been rounded off and the rock is frequently gneissic or schistose from the enormous stresses to which it has been repeatedly subjected since its original crystallization. The prevailing cast of color of this granite is light gray.

The second granitic intrusion often contains more orthoclase than the first, and the feldspars are frequently of a pink color. It seems to contain more biotite than the Laurentian and its crystal form is usually clear and sharp without much metamorphism subsequent to crystallization. The quartz is often cloudily rather than glassy. Many of its outcrops show a distinctive pink cast of color which, where present, is in some areas diagnostic between the Laurentian and the later granites.

This second granite, often referred to as the "intrusive granite" has had a profound effect in some areas in metamorphosing the Huronian formations. The Marquette Range shows increasing metamorphism from this granite as it extends to the west and southwest. Areas are mentioned by Smyth where this intrusive granite has floated and partially digested masses or floating islands of the Huronian rocks.

A striking characteristic of the occurrence of this second granite is that in only a few isolated places does it actually burst through and intrude the Huronian iron-bearing formations. In many places it domes them up or bends them into wide bows but the iron formations and their enclosing rocks have a persistent way of resisting actual intrusion by this granite. The result is that dikes of this granite are comparatively rare occurrences in the iron formation even in areas where the granite is of demonstrably later date than the iron formations and has a profound metamorphosing effect upon them.

For purposes of exploration it is therefore usually correct to assume that any large occurrence of granite, be it Laurentian or Upper Huronian in age, is basal in geographic position as far as the Huronian iron formations are concerned. Exceptions to this rule are severely localized.

The third granite which appears on the Michigan and Minnesota ranges can best be described as a granite with



Logging Camp in Winter, Land Department, of the Cleveland Cliffs Iron Co.

reservations. This granite is Keweenaw in age and is definitely intrusive into Lower Keweenaw volcanics. It has never been reported as intruding the Upper Keweenaw sedimentary series and is therefore probably Lower Keweenaw in age. The reservations as to this third granite as it appears in the Lake Superior mining district are that it is mainly not a granite but a gabbro. In places this gabbro differentiates into a very basic rock approaching the granitic in character and properly described as an anorthosite. The conspicuous minerals in this are large porphyritic crystals of labradorite feldspar in a dark ground mass which contains little mica and much augite and some hornblende, with comparatively little quartz. The prevailing color is very dark gray to black in fresh exposures.

If this rock, locally differentiating in the Keweenaw gabbro, may properly be called a granite, then there are three granites on the Lake Superior ranges. This rock is found on the west end of the Gogebic Range in the great gabbro there, and a similar rock is found with similar relations in the Duluth gabbro on the northwest side of Lake Superior.

In the Canadian districts there is difference of opinion as to whether two or three granites are present, and much of the difficulty in correlating between the Lake Superior iron ranges of the United States and the isolated mineral districts to the northeast and north of Lake Superior in Canada is due to the attempt to match the igneous intrusions from district to district in Canada and from these districts to the United States side of the Lake. Experience in Michigan has shown igneous hook-ups to be perilous in the extreme. The best evidence of this is the granite on the foot-wall of the Gogebic, which at the east end of the range is intrusive and in the central part of the range is typical Laurentian separated from the Huronian by a vast unconformity.

A similar difficulty has been the cause of endless discussion, beginning in the late sixties, on the Marquette Range, where part of the granite is clearly Laurentian and unconformable and part of the granite is clearly later in date than the iron-bearing rocks. Barrett has

suggested that much of the later granite is re-fused Laurentian.

Due to the wide gaps between areas and to discontinuity of sediments on the Canadian side, there is much confusion of terms and the writer has purposely avoided such Canadian terms as Algoman in referring to the later granite, because of the uncertainty as to correlation.

There is also considerable uncertainty as to the correlation between rocks called variously Keewatin, Huronian, and Keweenaw, in the Canadian area northeast of Lake Superior in districts remote from the lake. The United States picture in the Lake Superior region is for the most part clear, due to a better continuity and possibility of correlation among the sediments and to the existence of much shorter spaces to bridge as well as to the enormous amount of detailed geological work and exploration which has been found useful in tracing the great iron and copper formations on the United States side of the line.

In addition to the granitic intrusions, there has been a great deal of basic intrusion of the region by diorites and diabases in a wide variety of dikes, sills, and bosses, ranging in size from thin sheets to heavy dikes a quarter of a mile or more in width. Dikes of this family have been found making soft or molten contact with the Upper Huronian, or Presquele, granite, and many such dikes have been traced up into the Keweenaw. This class of dikes would therefore be of Upper Huronian and Keweenaw age and their absence in the Upper Keweenaw would indicate that they are probably all older than that formation.

The Upper Huronian dikes are probably in the minority and are possibly fore-runners of the Keweenaw outburst. The evidence seems to be that most of the basic intrusions are of Keweenaw age and may be correlated with, or viewed as, the fissure eruptions through which the great series of Keweenaw flows are believed to have erupted.

Subdivisions of Huronian Rocks.—The Huronian series is the main locus, and in the writer's belief possibly the entire locus, of the Lake Superior iron ore deposits. The Vermillion Range is the only one which is generally not believed to be



*Mahoning and
Hull-Rust Mines*

Huronian in age, being assigned to the Keewatin.

The subdivision of the Huronian rocks was a matter of discussion, and the reconciling of discrepancies from the beginning. The first endeavor which could be made to subdivide the Huronian was made on purely lithological grounds by the early geologists, Pumpelly, Brooks, Rominger, and the elder Chamberlin. Lithology has the advantage that lithological similarity is a definite and incontrovertible fact. It has the disadvantage that similar rocks can result from the recurrence of similar conditions in different times. When, however, lithological similarity combines with duplication of stratigraphic succession, the probabilities of error due to repetition of similar beds at different periods is greatly reduced. However, lithology and a very rudimentary and generalized knowledge of the stratigraphic succession of Lake Superior rocks, assisted by magnetic work with crude instruments and methods, sufficed Pumpelly, Brooks and one or two other early geologists to select lands in a few field seasons which have since produced hundreds of millions of tons of iron ore.

The first correlation between the Menominee Range and the Marquette was done by Pumpelly, Brooks, and Rominger (and especially by the last named) entirely on lithologic grounds. Later the unconformities were found which divided Lower, Middle, and Upper Huronian from one another on the Marquette Range. Correlation between the Marquette and the Menominee and between the eastern and western Menominee was then attempted purely on the basis of the unconformities.

An unconformity is commonly marked by either a conglomerate or a discordance of attitude of beds, or by both. Unconformities, however, have an elusive habit of failing to be exposed, or of being masked by fault slips along the unconformity, with the result that correlation between the eastern and western Menominee and between the Menominee and the Marquette did not fare so well, as far as accuracy was concerned, when the

finding of unconformities only was used as a criterion for correlation and determination of relative ages.

The various unconformities have since been fully located on the Menominee and on the Gogebic and it is found that the earlier correlations made on lithological grounds were in the main correct.

There are three Huronian periods: the Lower Huronian, the Middle Huronian, and the Upper Huronian. The greatest unconformity between them seems to be that between the Lower and Middle.

Lower Huronian.—The Lower Huronian consists, in Michigan, of a series of dolomites and quartzites, without any iron formation. This formation is found unconformably on top of the Laurentian granites or of the Keewatin schists. There is also a slate series in the Lower Huronian on the Marquette which is, for the most part, missing on the Menominee and Gogebic and which forms the whole of the lower Huronian (Knife Lake slate) where exposed on the Mesabi Range. Occasionally in the Lower Huronian dolomite are found remains of Algae, which are apparently the oldest life occurrences known in the world.

Middle Huronian.—The Middle Huronian is the main iron-bearing formation of the Lake Superior region. It includes the Negaunee iron formation of the Marquette, the Vulcan formation of the Iron Mountain district on the eastern Menominee Range, the Amasa formation of Iron County on the western Menominee Range, and the Ironwood iron formation of the Gogebic Range.

The bed-for-bed duplication of the Ironwood formation of the Gogebic on the Mesabi Range of Minnesota, as shown by the labors of Hotchkiss and Wolff, together with similar stratigraphic relationships with the enclosing rocks, has led the consensus of opinion overwhelmingly to the conclusion that the Biwabic iron member of the Mesabi Range is also Middle Huronian, although the unconformity beneath the overlying slate has not been as conspicuously proved or accepted as the corresponding unconformity between the Michigan Middle Huronian and its overlying slates. How-

ever, the overlying Virginia slate has been shown to truncate the Mesabi formation as the west end of the range is approached.

The Middle Huronian iron formation is characterized by a quartzite footwall at its base. This is in every case present but is only a mere selvage of a few inches on considerable parts of the eastern Menominee Range and is in large part masked by contemporary volcanics in the Amasa district of the western Menominee Range. The Middle Huronian iron formation may be separated into subdivisions which check very closely between the Mesabi and the Gogebic, not quite so closely between the Gogebic and the eastern Menominee, and moderately well between the eastern Menominee and the Marquette.

The iron-bearing rocks, when found in their original form, consist of cherty and slaty iron carbonates. These have been altered in different places in different ways. The alterations may be described as anamorphic and katamorphic. The katamorphic alterations consist of the breaking down of the original iron carbonates to iron oxides and the removal of the silica by leaching. This has been done by weathering agencies working either from the present or from various Pre-Cambrian terranes. In speaking of the present terrane, what is really meant is the immediately Pre-Cambrian terrane, because there is little evidence of important alteration of the ores since the laying down of the Cambrian. The mantle of flat-lying Pre-Cambrian and later rocks which not long ago covered the whole Lake Superior region has but recently been removed from the Michigan ranges. The eastern Menominee still carries large remnants of the former Cambrian blanket of sandstone and to the east passes under this blanket which reaches a thickness of 600 ft. on the shore of Lake Michigan in the region of Escanaba. The presence of the iron formation beneath the younger rocks has, however, been demonstrated both by drilling and by magnetic work to the



vicinity of Escanaba, a distance of some 30 miles from the point where the formations pass beneath the Cambrian rocks at Waucedah.

Numerous plasters, or remnants, of basal Cambrian sandstone can be found throughout the Menominee and Marquette regions indicating that the present rock topography is largely the Pre-Cambrian land surface recently cleared of its younger blanket. The basal conglomerate of the Cambrian contains numerous occurrences of fully concentrated iron ore pebbles and wash from neighboring ore bodies in the middle Huronian. From this picture it appears that the major concentration of the ores took place before the Lake Superior rocks sank beneath the Cambrian ocean.

There have been sporadic small operations for iron ore and for paint rock (yellow ochre) in the conglomerate at the base of the Cambrian sandstone, but nothing has been successful on a large scale due to the high silica content.

In Minnesota the later flat-lying rocks on top of the Huronian are Cretaceous in age. There are also pockety occurrences of the basement conglomerate of the Cretaceous which are rich enough to mine. They are usually high in alumina, and have been hardened in a manner which strongly suggests the case-hardening of the surface of tropical ores of today.

Even where the leaching was later in date, it is found that much of the oxidation of the original Middle Huronian carbonate from formations to hematites took place in immediately Pre-Upper Huronian time. This includes all of the oxidation on the eastern Menominee, most of the oxidation on the Marquette, part of the oxidation on the Gogebic, and much of the oxidation on the western Mesabi. Wherever extensive oxidation of the carbonates to hematites or limonites took place in Pre-Upper Huronian time, the subsequent burial under the Upper Huronian and deformations and mountain-building movements and intrusions which took place in Upper Huronian and later time have resulted in specularizing such hematites and limo-

nites as were formed prior to the Upper Huronian.

To this action can be traced the hard ore jaspers and specular hard ores of the Marquette, the blue porous specular ores of the eastern Menominee, the blue ores of the Gogebic and blue ores of the western Mesabi as well as the hard ores and specular ores and iron formations of the Vermillion. Where a specular hematite ore is found hard and compact, the evidence is that its oxidation and leaching were complete prior to Upper Huronian time and it has since been subjected only to the compacting and specularizing action of subsequent anamorphism connected with folding and high temperature. Where a specular hematite ore is found soft and porous, the evidence is that it was oxidized before Upper Huronian time but leached of its silica subsequent to Upper Huronian time. Specular hard ore jaspers result from Pre-Upper Huronian oxidation which has not been followed by leaching.

Where the section is complete, it is found that there was a Middle Huronian slate laid down upon the iron formations. As to the original thickness and quantity of this slate, evidence is lacking because in all of the districts it has been nearly all removed by erosion before the Upper Huronian was laid down. The Middle Huronian iron-bearing member reaches its thickest in the Negaunee basin of the Marquette Range where it amounts to 2,500 or 3,000 ft. This is believed to be due to a settling of the basin which continued at almost the same speed as the iron formation was laid down. In fact, much of the Upper Huronian folding was foreshadowed in Middle Huronian time. No sign of the overlying Middle Huronian slate appears on the Marquette, as any such slate, if it ever existed, was removed before Upper Huronian time. On the west end of the range, Pre-Upper Huronian erosion bites deeper and deeper until west of Champion on the south limb and between Diorite and Michigamme Lake on the north limb the entire Middle Huronian iron formation is missing and the Upper Huronian rests directly on the basement granite. The Negaunee iron formation

reappears in the Republic trough but is there deeply eroded by the Upper Huronian. Thence the formation has been traced around a great series of folds southward into the eastern Menominee district.

On the eastern Menominee a conformable Middle Huronian slate, known as the Loretto slate, appears in sporadic occurrences above the iron formation. On the central Mesabi the base of the Virginia slate appears to be conformable, possibly due to the preservation of a remnant of the Middle Huronian slate in contact with the iron formation. On the western Mesabi the Virginia slate appears to be unconformable, with some occurrences of conglomerate at its base. On the Gogebic there are some occurrences of Middle Huronian slate at the top of the iron formation, but for the most part the overlying Upper Huronian Tyler slate is unconformably in contact with the iron formation.

The Middle Huronian iron formations and their including and enclosing slates are in their original form cherty carbonates, and carbonate slates which alter with weathering to red slates. Where the weathering occurred prior to the laying down of the Upper Huronian, these formations and red slates have become specularized.

Therefore, throughout the Lake Superior region, the occurrence of specular iron formation or specular ore dates the formation as Pre-Upper Huronian in age. The converse, however, is not true, that all non-specular iron formation is later than Middle Huronian. No specular hematite has been found in Upper Huronian or later formations. Specular iron formation, where present, therefore, makes a positive determination that the formation is Pre-Upper Huronian in age.

Contemporary volcanics are present in the Middle Huronian of the Amasa formation, with an enormous thickness of Middle Huronian volcanics appearing below the iron formation; that is, the Amasa formation, which is contemporaneous with the Vulcan iron formation of the eastern Menominee and the Negaunee iron formation of the Marquette, was

laid down at the conclusion of a period of intense volcanic activity, which continued with reduced intensity into the period of iron formation deposition in the Amasa district.

Upper Huronian.—The Upper Huronian iron formation appears on the western Marquette Range where it is known as the Bijiki iron formation. It forms the main iron formation of the western Menominee Range, where it has been mined in Iron County, Michigan, and Florence County, Wisconsin and is known as the Iron River iron formation. Its presence on the eastern Menominee Range within the Upper Huronian slate series has been demonstrated but it has not been much explored. It is also present on the extreme eastern Gogebic near the unconformity below the Keweenaw. The Cuyuna Range of Minnesota also probably belongs to the Upper Huronian iron-bearing series.

The Upper Huronian iron formation, like the Middle Huronian, is a carbonate in its original form. The formation of ore in the Upper Huronian has also been by the oxidation and leaching of the original carbonate by atmospheric agencies. Unlike the Middle Huronian, the Upper Huronian has had only one period of exposure to atmospheric action since its formation. This was the period which closed with the laying down of the Cambrian sandstone.

The Upper Huronian formations are characteristically associated with pyritic, graphitic, black slate at every point where they have been identified. Such slates are never found in the Middle Huronian and their appearance is therefore diagnostic of Upper Huronian age. An exception to this would be in the Knife Lake slates of the Vermillion Range, if the present generally accepted Lower Huronian age be ascribed to these slates. These will be discussed later under the Vermillion.

The Upper Huronian iron formations are characteristically of shallower water deposition than the Middle Huronian. They are not closely associated with volcanic action. The alumina content is characteristically higher than that of the Middle Huronian, and the silica-iron ratio in the ores is usually lower than that of the Middle Huronian. The ores are rarely of as high grade as those of the Middle Huronian and they are never specular.

Marquette Range.—The Marquette Range was opened in the early years of the decade of 1840 and was the first of the Lake Superior iron districts to be discovered. Its essential structure consists of a great trough with east-west axis, whose eastern apex is at Ishpeming and Negaunee and whose open end is to the west. A subsidiary close-folded trough of northwesterly trend deeply corrugates the westward extension of the Marquette Range, closing off to the southeast at Republic. A southeasterly extension cut off by the Laurentian granite from the main Marquette trough is found in the Gwinn district.

The Marquette Range shows both Middle Huronian and Upper Huronian iron formations. Both have been mined but the production from the Upper Huronian has been trifling compared to that from the Middle Huronian.

The Middle Huronian series rests unconformably on the Lower Huronian Mesnard quartzite-Kona dolomite-Wewe slate series. The lowest rock of the Middle Huronian is the Ajibic quartzite, upon which rest about 150 feet of iron formation little worked on the Marquette



Deer on Grand Island Game Preserve

Range. Above this comes the Siamo slate, varying in thickness but averaging possibly 300 feet. This is, in its original form, a carbonate slate. Above this comes the main Negaunee iron formation of the Middle Huronian, which reaches a maximum thickness of some 3,000 feet at Ishpeming and Negaunee, a minimum thickness of zero west of Champion, and which is always unconformably overlain and truncated by the basal Goodrich quartzite of the Upper Huronian.

Much of the oxidation of the Middle Huronian formation has taken place in Pre-Upper Huronian time and a considerable part of the ore concentration was also Pre-Upper Huronian. The district subsequent to Upper Huronian time was folded into the great structures which have been described. The result is that the mines in the Middle Huronian go to great depths and ore bodies undoubtedly exist at very much greater depth than any yet reached. This range, in addition to being the first ore producer, will undoubtedly be producing ore after the other ranges of Lake Superior are history.

The ore bodies within the Middle Huronian are found in pitching troughs due to folding and due to the intersection of basic diorite dikes with the pitching folds. Some of those remote from the Upper Huronian are of later concentration and are therefore soft ores. There are also extensive and characteristic hard ore bodies found along and in the vicinity of the unconformity at

the base of the Upper Huronian, which throughout the producing areas of the Marquette is a quartzite known as the Goodrich quartzite. These hard ore bodies are in part specularized ancient soft ores which represent ore bodies formed on the Pre-Upper Huronian land surface before the advancing Goodrich sea invaded the exposed Negaunee iron formation. At the same time, placer iron ores were being formed by beach wave action, partly from destruction of the soft ores and partly by concentration of magnetite from neighboring granite exposures. These ancient placers have been indurated mainly into the black, magnetic, hard ores that are found in the base of the Goodrich above its contact with the Negaunee member. These black ores represent fossil placer ores whose closest present day analogue is found in such deposits as the black sands of Nome beach in Alaska. There are even a few spots where this hard ore in the base of the Goodrich has been found to contain small amounts of gold. These ancient placer iron ores have been indurated by deformation and heat subsequent to Upper Huronian time.

From Humboldt west is found the Bijiki iron formation of the Upper Huronian, located far out in the Upper Huronian Michigamme Slate series. This formation has been worked in a small way at scattered mines. The last operation in this formation was at the Imperial mine near Michigamme, which has recently been suspended.

The Upper Huronian iron formation is here narrow, averaging less than 200 ft. in width in this area with a pyritic, graphitic, black slate footwall and a gray slate and graywacke hanging wall. The ores, like all Upper Huronian iron ores are high in phosphorus and average 55 percent or lower in iron with fairly low silica, say seven or eight percent. The iron formation is enclosed within the great Michigamme slate series of the Upper Huronian which grades downward into the Goodrich quartzite at its base. In the lower part of the Michigamme slate, there is found a discontinuous volcanic formation known as the Clarksburgh series.

Menominee Range.—The Menominee Range includes Dickinson and Iron Counties of Michigan, and Florence County of Wisconsin.

The first mining operations took place in the early seventies near Waucedah on the eastern Menominee in Dickinson County. This formation is the Middle Huronian Vulcan member and was rapidly traced westward to the Menominee River at the Wisconsin boundary west of Iron Mountain. All of the mines on this formation have been largely worked out and abandoned, except the Penn group of mines immediately east of Norway.

The Middle Huronian, with steep southerly dip, rests unconformably upon the Sturgeon quartzite Randville dolomite series of the Lower Huronian. On top of the Lower Huronian is found a heavy and conspicuous conglomerate, above which is found a talc schist and slate series bearing on its upper edge a quartzite often only a few inches in thickness, known as the Traders quartzite. On top of this is the Traders iron formation member of the Vulcan series varying in thickness but averaging possibly 150 ft. This is conformably overlain by the Brier slate, which has an average thickness of some 200 ft. The

Brier slate is a ferruginous carbonate slate, dark gray in its unaltered form, and characteristically alters to a tan color. It carries within it two or three thin bands of iron formation.

The Brier slate is in turn overlain by the Curry iron formation, which is prevailingly a wavy-bedded, massive chert with coarsely granular phases. The thickness of the Curry formation varies widely due to the effect of the unconformity at the base of the Upper Huronian which in places bites deeply into the Curry formation and sometimes eliminates it and all the Brier and Traders, leaving the Upper Huronian Hanbury slate in contact with the Lower Huronian dolomite. The Traders, Brier and Curry members together constitute the Vulcan iron formation.

The Curry member, where developed in considerable width, carries in its upper portion bands of slate and is in places overlain by a conformable Middle Huronian slate known as the Loretto slate.

The Traders formation corresponds in position to the lower iron formation on the Marquette and to the Plymouth iron formation on the Gogebic. It especially resembles the Plymouth formation in having a lower wavy-bedded portion and an upper straight-bedded formation which divides the Traders members approximately in half. The ore is usually found in this upper division. The Brier slate corresponds in position to the Siamo slate of the Marquette Range and the Yale slaty iron formation of the Gogebic. The Curry, as usually developed in moderate thickness, corresponds approximately to the Norrie member of the Gogebic, and where the upper slaty members appear in the Curry these may possibly be the equivalents of the Anvil

and Pence slates of the Gogebic iron formation. The Curry member carries probably less than a third of the ore of the Eastern Menominee, which, where present is found at the base of the Curry.

The ore bodies on the eastern Menominee are, like other Lake Superior ore bodies, associated with solution channels. These are controlled, in order of importance, by (1) fault intersections with the iron formation; (2) fault troughs formed by displaced blocks in the iron formation and its enclosing rock; (3) fold troughs in the iron formation. The iron formation is nearly all oxidized and a considerable part of the hematite has been specularized, indicating that the oxidation took place largely before the Upper Huronian was deposited. The ores are mainly soft, porous, specular ores resulting from oxidation in Pre-Upper Huronian time and subsequent leaching occurring mainly in later time.

The Middle Huronian iron formation series is overlain unconformably by the Upper Huronian slate series, locally known as the Hanbury slate. This, like other Upper Huronian slates, is a clay slate rather than carbonate slate. It is at times graphitic. Its base occasionally shows a conglomerate but this has usually been masked by heavy shearing which has occurred along the contact during the folding of the rocks.

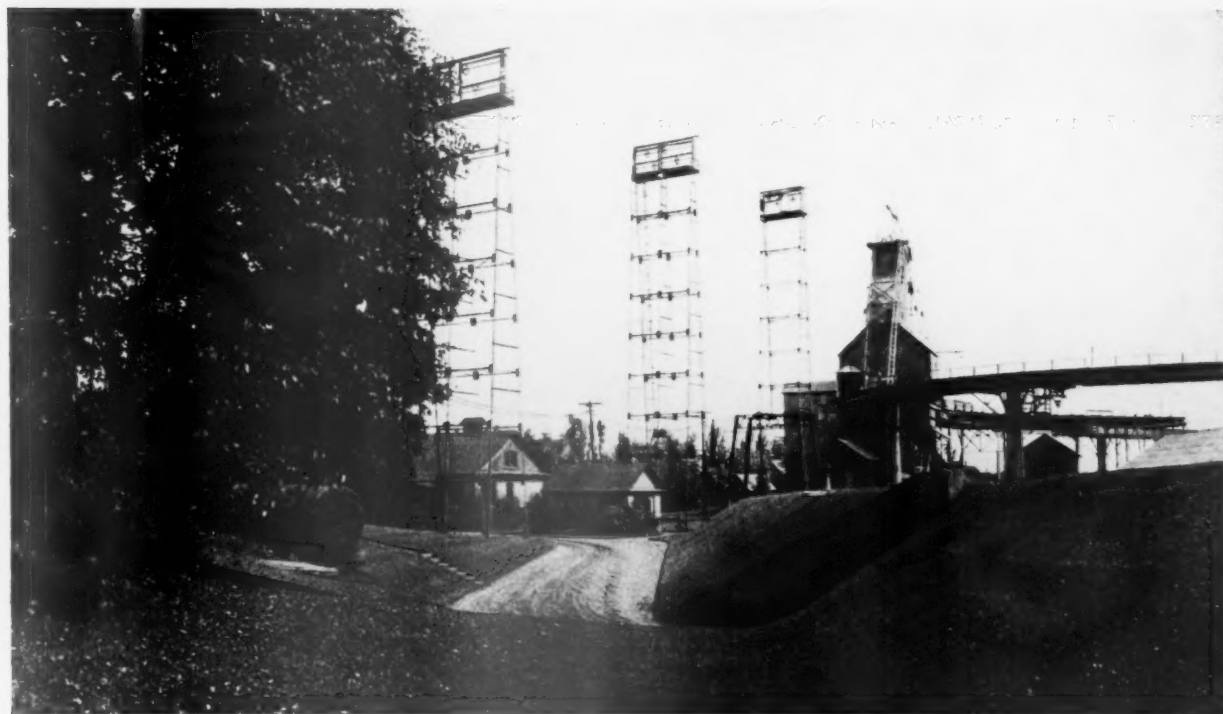
The old Menominee Range shows three different repetitions of this Middle Huronian iron formation, mainly by faulting and partially by folding. Of these, only the south two have been productive, and the southernmost has produced nearly all the high-grade ore that has been shipped from the eastern Menominee. A fourth and fifth fold repetition were worked in early days at Felch

Mountain and Calumet, about 15 miles to the north.

High up in the Upper Huronian slates is an iron formation corresponding to the Bijiki iron formation of the Marquette Range, and to the Iron River iron formation of the Western Menominee. This formation has a graphitic black slate footwall, a gray slate hanging wall, and what little ore has been found in it is for the most part high-phosphorus. It has not been commercially developed.

The Florence, Crystal Falls, and Iron River districts were opened in the early eighties and comprise the western Menominee Range located in Florence County, Wis., and Iron County, Mich. With the exception of a single belt of formation, called the Amasa formation, these districts work entirely the Upper Huronian high-phosphorus iron formation, with the pyritic, graphitic, black slate footwall, and massive, gray slate and graywacke hanging wall which characterize this formation. This formation has numerous bands of graphitic, slate within it. It is divided roughly into thirds in thickness. The bottom third is slaty and cherty with black slate bands. The middle third is massive and cherty with much ferruginous graywacke on the west side of Iron County. The top third is cherty and slaty with thin black slate bands, and grades upward through a massive hard black slate into the gray slate and graywacke hanging wall slate of the region.

The Amasa formation in Iron County is Middle Huronian. It is separated by a conglomerate from the overlying Upper Huronian slates; intimately associated with contemporaneous volcanics, called the Hemlock greenstone, at its base. The Middle Huronian formation produces medium-phosphorus to basic-



The Athens Mine

MARCH, 1936



Holmes Mine, Ishpeming, Mich.

phosphorus ores which are in part specular but for the most part have been concentrated in Post-Upper Huronian time. The ores in the Amasa belt are localized along intersecting fault fractures and in gentle flexures in the steep dipping formation.

The other Iron County-Florence County ores are located in intensely folded areas of the Upper Huronian Iron River iron formation and are found mostly in the footwall third of the iron formation in pitching synclinal folds. The central third of the formation carries sporadic ore occurrences. The hanging wall third of the formation is occasionally found to be productive in the shatter zones occurring in sharp anticlinal bends in the formation. The average normal width of the Upper Huronian iron formation in Iron County is a quarter of a mile.

The Upper Huronian ores of Iron and Florence Counties are high in phosphorus, rather high in alumina, and prevailing carry about enough lime and magnesia to take care of the phosphorus as apatite. The silica-iron ratio is lower than in the Middle Huronian ores. Manganese is found in sporadic occurrences in the Iron County Upper Huronian ores and where found is in the form of Braunite and Hausmannite, making these manganiferous ores exceedingly hard. The footwall black slate is heavily pyritic and graphitic and where found in direct contact with the ore is likely to catch fire in mining unless a shell of ore or iron formation is left to keep it from contact with the air.

The Upper Huronian ores are largely red hematite and in part are limonitic yellow-brown ores. The folding in the Upper Huronian reaches a maximum of intensity in the Iron River district, where fold has been superimposed upon fold to a degree of complication that would hardly be believed by one unacquainted with the district. The more intense the folding, the better the chances are for ore and the more complicated is the geology and exploration work.

Like all other Upper Huronian ores, these ores are referable to oxidation

from practically the present land surface. The original carbonate iron formation is found unaltered at depths varying from ledge to an extreme of well over 2,000 ft., with no carbonate yet in sight. No rule for the prediction of carbonate occurrence has been evolved beyond the general fact that the more intense the folding in an area the deeper oxidation is likely to go. Shallow occurrences of carbonate reflect their presence in an irregular and high magnetic profile. There are no specular ores or specular iron formations in the Upper Huronian on the Menominee or elsewhere. The reserve of high phosphorus ores of the Western Menominee is large in comparison with recent demand and the future of the district may therefore be expected to be long. The Amasa formation has been worked at only a few mines and is now idle with one reserve property not yet opened.

Gogebic Range.—This range was known in the seventies but not opened till the early eighties.

The basement rocks of the Gogebic Range are Laurentian granite and Keewatin schist, at different parts of the district. On top of these, where not removed by overlying unconformity, there appears a Lower Huronian dolomite-quartzite series known as the Bad River limestone and the Sunday quartzite. On top of this is a profound unconformity, above which comes the footwall slate of the range, grading upward into a vitreous quartzite called the Palms quartzite. On top of this comes the Ironwood iron formation, which is divided into a number of members.

The Plymouth member lies on top of the quartzite footwall and corresponds in position to the Traders on the Menominee and to the Lower iron formation below the Siamo slate on the Marquette. At the eastern and western ends of the range, the Plymouth formation carries a slate, locally called the "footwall slate," in its lower portion which is separated from the quartzite foot by a granular and oolitic chert horizon. In the central portion of the range the footwall slate is missing or is represented by a selvage of an inch or two.

Above this slate is found a wavy-bedded chert series occupying about half the thickness of the Plymouth member. On top of this is a straight, thin-bedded series which grades upward into the Yale slates. These Yale carbonate slates, with included iron formations, correspond in position to the Brier slate of the Menominee and to the Siamo slate of the Marquette. Above the Yale formation comes the massive, wavy-bedded chert called the Norrie formation, which in position corresponds to the Curry member of the Menominee and to the main Negaunee iron formation worked on the Marquette. Above the Norrie chert comes the Pence slate series, carrying in places a thin conglomerate at its base, and beyond this comes the Anvil slates.

The Pence and Anvil slates and their associated cherts correspond to the slaty bands of the upper part of the Curry formation on the Menominee Range.

In the central portion of the district, under the best conditions, iron ore bodies are concentrated right across the entire series. On the range as a whole, the Plymouth member is the most productive. One very fine ore body has been worked along the conglomerate horizon at the base of the Pence. Considerable ore has been found in the Anvil formation. The Yale formation is the locus of a heavy bedding fault which follows the range from Sunday Lake west and which, where it has broken up the Yale slates sufficiently, has caused ore concentration in them. A closely similar relation between a fault and the Brier slate has produced at least one important ore body on the eastern Menominee.

The major factor in the concentration of ores on the Gogebic has been the diorite dikes which intrude across the formation at about right angles to the dip and with a southeasterly dip, which produces a series of eastward pitching troughs by intersection of the dikes with the footwall and with impervious horizons in the iron formation. A few westward-pitching later diabase dikes are found, with less concentrating influence on the ores.

Above the iron formation comes the Pabst conglomerate, which marks the unconformity at the base of the Upper Huronian Tyler slate. The whole series on the Gogebic pitches steeply northward with great uniformity from end to end of the range, and strikes approximately east and west. The Tyler slate is unconformably overlain by the Lower Keweenawan traps with a conglomeratic quartzite at their base. Topographically the Gogebic Range lies in a valley between the granite and Keewatin schist footwall hills and the Keweenawan trap range to the north.

Specular hematite is present on the Gogebic but in nowhere near the relative amount that is found on the eastern Menominee and Marquette ranges. It increases in quantity to the east as the Presquele granite intrusion is approached. In part, the Gogebic formation has been oxidized in Pre-Upper Huronian time but in the most important amount since Upper Huronian time. Practically all of the ores have been formed since the Upper Huronian, with the result that the Gogebic ores are prevailing soft ores. Here and there are bodies of soft, blue, specular ore which would appear to have been oxidized in Pre-Upper Huronian time but leached of their silica in later time. The range is of most importance economically where

the dikes and their resulting eastward-pitching troughs are most closely spaced; where the width from the footwall to the trap range is greatest; and where a serotated trap range sky-line reflects the presence of many cross faults.

The eastern end of the Gogebic Range from Sunday Lake east has been fed up against Pre-Keweenaw erosion by a big fault or group of faults known as the Sunday Lake fault. The result is that the overlying Upper Huronian slate has been removed east of this fault displacement and the Keweenaw flows and their underlying basement conglomerate are found directly on top of the Plymouth member of the Gogebic Range iron formation, which in this area attains unusual thickness. This means that the eastern end of the Gogebic Range has received an extra period of weathering immediately before Keweenaw time, which has not affected other Middle Huronian iron formations. This weathering has been effective in the concentration of ore in the area east of Sunday Lake in portions of the formation which elsewhere are often barren.

The east end of the Gogebic Range is cut off and floated by Presquele granite near the west shore of Gogebic Lake.

Westward the Gogebic Range formation has been traced to a total of some 70 miles in length, but from a point a few miles west of the Wisconsin-Michigan boundary line, in Wisconsin, the Gogebic Range has been found unproductive. This unproductive condition reflects the close approach of a great Keweenaw intrusive mass of gabbro, which locally, in the vicinity of Mellen, Wis., becomes anorthosite, or "black granite." Under the influence of this intrusion, the iron formation has developed into a grunerite-magnetite schist which successfully resists all attack by atmospheric agencies. The formation not having been concentrated to ore before the intrusion occurred, no hard ore is found although considerable specular hematite in the iron formation registers the fact that some oxidation had taken place before the intrusion occurred and probably before the laying down of the Upper Huronian.

The Upper Huronian rocks on the Gogebic have only shown the presence of iron formation in a few places on the east end of the range and nowhere in productive quantity. The breadth of Upper Huronian slate outcrop between the Middle Huronian and the trap rock in the central portion of the range in the area between Montreal and Ramsay suggests the possibility that the Upper Huronian iron formation may there be present, though it has not been discovered.

The Tyler slate is in the main a clay slate series with some graphitic phases. It is often cherty at its base where it contacts with the Middle Huronian iron formation. The dikes are partly Keweenaw in age, as some of them intrude the Lower Keweenaw traps. A few are clearly pre-Keweenaw by their relationships to faults. They are all displaced by the great bedding fault.

The ore bearing limits of the Gogebic range lie between Tyler's Fork river in Wisconsin and a few miles east of Wakefield, Mich., a total of about 40 miles. West of Iron Belt, Wis., and some six miles east of Sunday Lake in Michigan, the ore bodies found are too small for current commercial conditions. This leaves some 25 miles length of productive formation. The termination, both east and west, of commercial ores, is due mainly to baking by igneous intrusions.

In depth the unaltered carbonate has only been found at one area in Ironwood near the Wisconsin line. Elsewhere the probabilities of extension below present known depths of 3,000 feet are good.

Mesabi Range—This district of Minnesota was discovered to have commercial value in 1891, and its mushroom growth and almost unbelievable productivity made history in the iron mining industry for the next quarter century, by which time its limits were fairly well known but its tonnage only scratched. The excavation of this district to date far surpasses in volume that of the Panama Canal.

The Biwabic iron formation of the Mesabi Range is practically a duplication of the Gogebic Range and seems to be the upturn of that range reappearing on the northwest side of Lake Superior after dipping under from the south. The Mesabi Range formations, however, dip very gently to the south rather than steeply to the north. This dip is so gentle that the breadth of outcrop of the Mesabi Range iron formation compared to some 700 feet on the Gogebic is usually as much as a mile on the Mesabi and in places reached a width of three miles although the formation is not far from the same thickness as the Gogebic. Dikes, which are so prominent a feature of the Marquette and even more so on the Gogebic, are as scarce on the Mesabi as they are on the Menominee range. In fact, of all the districts, the Mesabi Range is the hardest to associate directly with the igneous action, either contemporaneous or intrusive.

The iron formation, called the Biwabic formation, in its unaltered form is a series of cherty carbonates and greenalites. It is divided into four members, where fully developed. These are from bottom to top the lower cherty, the lower slaty, the upper cherty, and the upper slaty members. The lower cherty member corresponds to the Plymouth member of the Gogebic; the lower slaty to the Yale member; the upper cherty to the Norrie member; and the upper slaty group to the Pence and Anvil slates and their associated cherts. The footwall is the Pokegama quartzite, which grades downward into a footwall slate just as the Gogebic Palms quartzite does.

The overlying slate is the Virginia slate, which is in all respects similar to the Tyler slate of the Gogebic, being a clay slate somewhat cherty at the base and containing graphitic phases. The earlier investigators of the Mesabi Range found no evidence of unconformity between the Virginia slate and the underlying Biwabic iron formation. Comparison with Michigan indicates that there should be such an unconformity. We have seen in Michigan that this same unconformity is often elusive and was late in being found.

The fact is very clear, however, as further work is done on the western Mesabi, that the subdivisions of the iron formation successively thin out and vanish to the westward from the top down, their places being taken by the Virginia slate until finally, at the extreme west end of the range, the lower cherty member is all that is left of the Biwabic formation. At the same time it is noteworthy that specular ores and specular formations and wash ores containing specular hematite are more conspicuous at the west end of the range and in proximity to the Virginia slate contact. Various investigators, notably Wolff, Gruner, and Zapffe, report conglomerate at the base of the Virginia slate on the west end of the range. These evidences, together with the close correlation with Michigan formations, render it reasonable to suppose that the main body of the Virginia slate is Upper Huronian and rests unconformably upon the Middle Huronian formations of the Mesabi Range. Some Minnesota geologists consider this unconformity still unproved, but most are willing to accept it as probable. The contact between the Virginia slate and the Biwabic iron formation is not frequently exposed in the main portion of the range, but it is visible on the west end of the range, where the truncation by the Virginia takes place. It is from this area that the reports of conglomerate come.

The ore bodies of the Mesabi Range are found variously located in the iron formation, at times occupying almost its entire thickness. For the most part they are clearly the result of direct oxidation and leaching of silica at the present land surface. Their extent in depth below



Trappers Shack on Grand Island After a Heavy Snow Fall



Model 88-C Bucyrus Steam Shovel Loading Trumbull Wash Ore into 30 Cubic Yard Western Air Dump

the present land surface is moderate and they bottom usually on unoxidized or little-oxidized iron formation, described locally as "taconite." The ores have never been found to extend below any considerable area of overlying Virginia slate. These ores have been concentrated on the present land surface as it slowly migrates down and hence southward along the gentle southerly dip of the iron formation. The ore bodies are localized on minor flexures in the iron formation. Recent glacial action has evidently removed vast tonnages of Mesabi ores which must have existed in pre-glacial time.

The Mesabi Range ores are low in phosphorus, like all other Middle Huronian ores. Their formation at and close to the current land surface by weathering processes has resulted in soft, friable ores which require special treatment, either by mixture or otherwise, to prevent serious dust losses in the blast furnace. There are large volumes of oxidized but only partly leached iron formation on the Mesabi where the original granules of the chert have been separated by natural leaching, but have not themselves been dissolved. Such ores are treated in considerable quantity by water washing before shipment. Sintering is also used to raise the iron content, lower the moisture, and improve the physical structure of some ores. The wash ores are found especially on the western portion of the range.

The east end of the Mesabi Range, like the west end of the Gogebic, has been closely approached by a Keweenawan gabbro intrusion which has metamorphosed the Mesabi Range formations and rendered them unamenable to the ordinary surface weathering processes of natural ore concentration. The eastern Mesabi, therefore, contains a long stretch of formation in which the original carbonate and greenalite, only partly oxidized when the intrusion came, have been altered to grunerite-magnetite schist, with some specular hematite, by the action of the Keweenawan intrusive. A

large scale and pretentious effort has been made to concentrate this formation magnetically at Babbitt, but this did not prove commercially possible at prices which were obtainable for ore in the decade following 1920.

The Mesabi Range, the giant of the Lake Superior iron ranges, has an east-west length of commercial production of some 70 miles. The ore bodies, compared to the two or three thousand foot depths of all the other ranges except the Cuyuna, are all shallow, few reaching 500 ft. in depth. The great breadth of outcrop, caused by the flat dip of the formation, results in large, shallow ore bodies outcropping at ledge surface. Most of these are mined by stripping and open-pit methods.

The Mesabi ores are for the most part fully drilled, their tonnages and locations are known, and chances of future extension are not great. The reserve is large, but its end can be forecast already. Twenty years of operation at pre-depression levels would see the end of most of the large producers, and 30 years would, for the most part, exhaust the range.

Present thought inclines to about double each of these figures. Whether estimates of rate of production in the future are possible or not, tonnage figures are known for this range with reasonable completeness.

Cuyuna Range.—This district of Minnesota was the last to be opened. It was discovered in 1903, mainly on account of magnetic anomalies which occur in the more intensely folded areas of the iron formation. These folds, by shattering and making the formation amenable to the percolation of surface waters, have localized most of the ore bodies. They have locally caused gruneritization of the formation which bottoms the effect of the weathering, and hence the ores.

The Cuyuna Range, Deerwood iron formation, consists in its original form of slaty iron carbonate, which in the main portion of the range is largely manganeseiferous. The footwall of the range is a quartzite which closely re-

sembles the Pokegama quartzite and which grades downward into a gray clay slate. The hanging-wall rock of the range is a conformable, graphitic, black slate which grades upward into a coarse graywacke containing little quartz. In places there are chloritic schists in contact with the formation, which have been classified by Harder and Johnson as of volcanic origin. These chloritic schists are closely localized. The Cuyuna Range ores are all high in phosphorus.

The range is subdivided into two regions. The southernmost, called the South Range, is a monoclinical, southward-dipping formation usually 300 ft. or less in thickness, which carries bodies of high-phosphorus iron ore and little or no manganeseiferous ore. The North Range, which is the main portion of the Cuyuna Range, and the only part now working, consists of a heavier formation, running about a quarter of a mile in thickness. It contains both manganeseiferous ore horizons and iron ore horizons, all in the high-phosphorus class. Detailed mapping of the Cuyuna Range shows its main north portion to be a folded repetition of the same iron formation in a great series of southward, overturned, close folds, striking at an average about North 60 degrees East. In places, in the vicinity of Iron-ton, concentration actually reaches the bottom of these folds and resembles fold trough concentrations of Iron County, Mich. In most areas on the Cuyuna Range, the bottoms of the fold troughs are at unknown depths below the oxidation surface and the ore bottoms on hard, black, iron carbonate at comparatively shallow depths.

The unaltered carbonate carries a comparatively high alumina content and in the oxidation and leaching of the ores it is found that this alumina as clay filters mechanically down through the porosity of the ore and concentrates in the bottoms of the ore bodies in a heavy kaolin concentration which terminates or greatly impedes further progress of oxidation and leaching in depth. In some of the mines, in the height of a single drift can be seen the transition from hard, black, unaltered manganeseiferous, carbonate iron formation to soft, yellow, manganeseiferous, iron ore, with 2 or 3 ft. thick of kaolinized material on top of the carbonate. The monotonous, steeply southward-dipping beds of the thin-bedded iron formation can be seen passing continuously from the unaltered carbonate formation, through the kaolinized zone, up into the fully leached manganeseiferous iron ore, and bed for bed can be traced from the one to the other. This is the most dramatic and convincing evidence of surface leaching action to be found in so small a compass anywhere in the Lake Superior Region.

The Cuyuna Range is less certain in its correlation than most of the other districts. The footwall quartzite is admittedly like the Middle Huronian. It is, however, much less compacted and silicified. From the character of its ore and its rock associations, the Deerwood appears to be Upper Huronian and probably represents an iron formation high up in the Virginia slate. The total absence of outcrop for many miles around the Cuyuna Range renders it impossible to guarantee this, but there is outstanding regional evidence, much of it unpublished, which favors this correlation.

The Cuyuna Range is known to exist from as far east as Aitkin to as far west and south at Little Falls, a total

length of more than 50 miles. Its known width north and south at the widest exceeds 10 miles. The possibilities for further extension and development are great.

Vermillion Range.—This district of extreme northeastern Minnesota was opened up in the early eighties.

The Vermillion Range is, by the preponderance of current geological opinion, assigned to the Keewatin in age, which would make it far older than any of the Huronian iron formations we have been discussing. The early geologists viewed it as the equivalent of the Negaunee iron formation of the Marquette Range, which is Middle Huronian.

The basement rock of the iron-bearing series is the Ely greenstone, and the Soudan iron-bearing member of the Vermillion Range is intimately interleaved with the upper portion of the Ely greenstone and, like the Amasa formation of Iron County, marks the ending off of a great period of volcanic action. The volcanic association on the Vermillion is, however, more intimate than that of any other district in Lake Superior. This volcanic association is contemporaneous and not intrusive. The iron formation in its unaltered condition seems to be a carbonate similar to most of the other districts. Its alteration to ore has taken place by percolation of surface waters moving in structural troughs caused by intricate folding of the iron formation, and with it the greenstone. There are numerous flows interleaved in the iron formation, and the entire story is so intricate that it will probably never be fully deciphered.

The iron ore bodies occur in fold troughs in two major areas, one at Tower and Soudan and the other at Ely, on the east end of the range. The ore lies in the bottoms of these troughs, extending up from the bottoms in steadily thinning bands until it ends upward in unconcentrated jaspers. These concentrations are largely ancient, all of the iron formation and the ore associated with it being of specular type. Some leaching action has taken place at some period later than the original concentration of ore and has produced softer and more porous, but none the less specular, hematite ores, resulting from the later leaching of areas whose main oxidation took place in very ancient time.

Many areas of iron formation associated with the Ely greenstone are found over a wide area, but only the original discovery mines have proved productive, and an enormous amount of exploration of other areas of formation has been disappointing.

The ores are low in phosphorus, in-

cluding both hard and soft specular hematites, and are some of the finest in the Lake Superior region. They are found extending persistently to great depth. There is a long future ahead of the district in the present known ore bodies, but the future for other developments is not so bright.

The cause of the induration and specularization and metamorphism of the Vermillion Range is not far to seek. Beside the intense close folding and evidences of former deep burial in the crust of the earth, the area has been intruded by a granite, whose relationships will be discussed later.

The Knife Lake slate series, which overlies unconformably the Vermillion Range series, is a group of graphitic and clay slates closely resembling the great Upper Huronian slate series of Michigan, and within this slate series occurs a thin iron formation called the Agawa formation. This series is correlated with the Knife Lake slates and is generally accepted as being the same slate as the one which unconformably underlies the Mesabi Range. This makes it Lower Huronian in age by the accepted correlation. The Knife Lake slate series is also intruded by the granites which have assisted in metamorphosing the Vermillion iron formations. This granite has been correlated with the Giant's Range granite of the Mesabi Range. If this granite, which intrudes the Vermillion Range and the overlying Knife Lake slates, is actually the same granite as the Giant's Range granite, then, of course, this positively throws the Vermillion Range back into the Keewatin beyond discussion. This granite would then be the same one that furnishes boulders to the base of the Middle Huronian. It also intrudes the Lower Huronian Knife Lake slate, which lies under the Mesabi Range unconformably, and which lies unconformably above the Vermillion.

This is the formidable line of evidence on which the Vermillion Range iron formation has been thrown back into the Keewatin, and if all of these facts are positive the Keewatin correlation necessarily follows and is for these reasons

accepted currently by practically all geologists.

This correlation, however, introduces a discordance between the Michigan and Minnesota sides of the lake which seems grave and rather surprising. Elsewhere in Minnesota is a dolomite-quartzite series, called the Koochiching, which seems to fit into the picture below, or older than the Vermillion Range formations. Such a formation is elsewhere unknown in the Keewatin, but is precisely duplicated in the Lower Huronian of all the Michigan mining districts. Again, graphitic slates are not in Michigan known to exist elsewhere than in the Upper Huronian, yet the Knife Lake slates in the Vermillion region are graphitic and, furthermore, contain an iron formation just as the Upper Huronian slates carry an iron formation in Michigan.

The Keewatin in Michigan carries no iron formations. Certain formations in the Dead River area of the Marquette Range were at one time classed as Keewatin, but are mapped as Negaunee in Monograph LII.

The Post-Laurentian granite on the Michigan side is Upper Huronian in age, intruding and metamorphosing all ages of formation older than the Keweenaw. The Post-Laurentian granite of Minnesota is by the accepted classification treated as Lower Huronian in age, furnishing boulders to the base of the Middle Huronian. This seems a major discrepancy between the two sides of the lake.

When the entire Michigan series from the Laurentian through the dolomite-quartzite series of the Lower Huronian; the Middle Huronian type of iron formation and its enclosing rocks, including a hard ore horizon at its top; a graphitic slate series, with quartzite base, and containing a high-phosphorus iron formation, unconformably above this; and finally a higher eruptive series of rocks similar in type to the Keweenaw; when all of these conditions are found faithfully duplicated as far away as the iron-producing regions of India, it seems surprising that there should be such a discordance between areas as close as the Michigan and Minnesota ranges.



Crushing Plant
at the
Tilden Mine

It is, therefore, suggested as a possibility for consideration and test, that the intrusive granite of the Vermillion area is a later granite than the Giant's Range granite which lies below the Mesabi, and that the so-called Knife Lake slates of the Vermillion are not the same as the similarly named slates which unconformably lie below the Mesabi formation. The graphitic Knife Lake slates of the Vermillion would then be Upper Huronian, containing, like other Upper Huronian slates, an iron formation locally known as the Agawa. The granite intruding them would be late Upper Huronian and would correspond with the intrusive granite of the Michigan ranges. The Vermillion Range formation would be brought up to the position originally assigned it, as Middle Huronian, equivalent to the Negaunee of the Marquette and to the Amasa district of Iron County.

The Vermillion Range formation occurs at the close of an intense period of vulcanism, like the Amasa formation of Michigan. Similar Middle Huronian eruptives are found on the east end of the Gogebic.

The Mesabi formation would then tie in with all the other Middle Huronian formations as closely following a period of eruptive action. The Koochiching would become Lower Huronian and the entire cross section and igneous history would harmonize on the two sides of Lake Superior.

As a test for this, radio-active analysis offers a convenient method of approach. Comparison could be made of the age of the granites of the Giant's Range and of the Vermillion area, and these in turn could be compared with the Presquele granite in Michigan. The greenstones of the Ely series could be compared with the Hemlock greenstones in Michigan by the same line of approach.

This tentative change in current correlation is not offered as a certainty, but quite deliberately as a mark to shoot at, either for proof or disproof, and in the effort to harmonize conflicting geological sections on the two sides of Lake Superior. It has not the sanction of geological opinion in general.

Influence of Geologic History on Type of Ore and Methods of Production.—The great structural features of the Lake Superior region have controlled the physical condition, position, attitude, and type of occurrence of the iron formations and of their ores. The larger regional folds have produced the tilts or high angles at which most of the ranges other than the Mesabi are found to lie. The entire geologic history of each ore occurrence reflects upon the methods by which it can be mined and made marketable, and the uses to which it can be put in the steel industry.

The long period of Pre-Upper Huronian oxidation and leaching which occurred on the Marquette before the Upper Huronian was laid down and before the great Marquette Basin was folded into its present form, has determined the outstanding characteristic of the Marquette Range; namely, the steep dips and the persistent extension of ore bodies and groups of ore bodies to and beyond any depth so far reached in the better part of a century of mining.

The protection of certain areas from extensive leaching, and in part from oxidation, has resulted in the siliceous ores of the Cascade district on the south margin of the Marquette trough, where major faults have thrown the unoxidized and unleached iron formations from

great depths to their present location.

The tremendous induration of the formation on the Marquette by deep burial and intrusion in late Upper Huronian time has contributed to produce in many parts of the formation a hardness both of ore and of wall rocks which has rendered open stopping methods more available on this district than on most of the others.

The induration of ancient soft ores in the squeeze and heat of subsequent folding and intrusion has created the characteristic hard ores of the Marquette which will sink like lead through the slag bath of an open-hearth furnace to oxidize the metal beneath. Closely similar conditions have produced the hard ores of the Vermillion.

The hard ores along the contact of the Upper Huronian with the Middle Huronian are found only where the overlying Upper Huronian is quartzite. Where the Upper Huronian slates lie directly against the underlying Middle Huronian iron formation, no such hard-ore zone exists. The reason for this is obscure, but presumably lies in the difference between beach and wave-washing, weathering and oxidizing conditions and the reducing conditions without weathering action which would be found underneath tidal mud flats.

The type of iron formation exposed under that long-vanished land surface at the base of the Upper Huronian profoundly affects the character of the hard-ore deposits and their availability for mining. The existence of massive, red and specular jaspers in the vicinity results in pebbles and boulders of this material in the hard-ore zone, which then is found too low grade to mine.

The character of the quartzite in the base of the Upper Huronian again affects the fragmental or fossil placer hard ores found just above the unconformity. If the quartz grains are large, wave-washing action could not separate them from the fine grains of the magnetite-hematite sand, and low-grade black ores result.

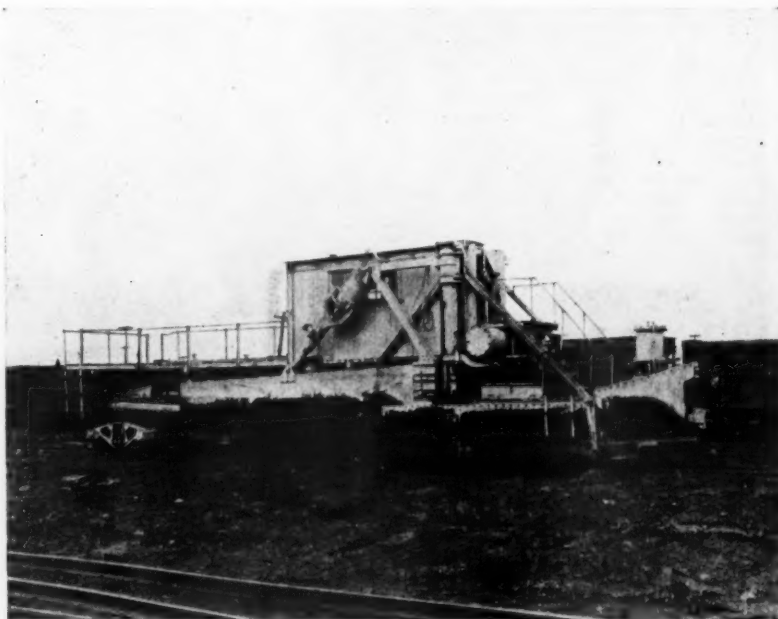
The fact that oxidation was well ad-

vanced on the eastern Menominee in the Middle Huronian iron formation before the Upper Huronian slates were laid down has resulted in specular ore. That leaching was largely postponed until later than Upper Huronian time, has resulted in these ores being porous, soft, specular material rather than massive hard ore as they would have been if leached prior to the Upper Huronian.

The Gogebic Range would have been of little value had it not been for the occurrence of large numbers of dikes which have promoted water circulation and the concentration of trough ore bodies. The ratio of blue ore to red ore on the Gogebic is apparently the ratio of Pre-Upper Huronian to Post-Keweenaw concentration.

The concentration in comparatively recent time of the Mesabi and Cuyuna ore has resulted in soft ore bodies spreading out at ledge to a size which has justified open-pit operation.

One of the most direct influences of the entire geologic history and set-up of an ore deposit is found in its relation to subsidence and to the stability of mine openings. A striking comparison of open-pit operations on the Mesabi Range and on the other ranges is afforded in the behavior of the pit banks. The Mesabi Range beds are for practical purposes horizontal. The open pits on the other ranges work beds with an average dip of over 60 degrees. A comparison of the behavior of the two may be illustrated by piling "Saturday Posts." If this be done horizontally, a high pile can easily be built which will stand indefinitely. If the attempt be made to pile the magazines vertically, it will be found that this can only be done if there are no free planes at the edge. As soon as one surface of the pile is free, collapse will result. In the same way an open pit in a steeply dipping series of beds will not stand with as steep a bank as an open pit in a horizontal series of otherwise similar beds. That is, experience has shown that Mesabi Range open-pit practice must be modified to meet



Jordan Scraper Plow, Used for Plowing Dumps



General View of the Hill Trumbull Pit

the conditions of other ranges with steeply dipping beds.

Certain rocks are subject to rapid weathering on exposure to air, with consequent slacking and squeeze. This action will close drifts driven through such rocks and will cause serious sluffing in pit banks. The worst offenders in this regard are rocks which have been subjected to anamorphic processes subsequent to their deposition. The talc schists are the worst behaved. These rocks result from original complete weathering processes followed by subsequent development of schistosity, with accompanying new minerals which are very unstable on exposure to air and moisture.

In all places the behavior of the rocks and ores in mine openings is controlled wholly by the history through which they have gone. In general, the large-scale subsidence of Pre-Cambrian rocks is apt to be slower and at a more uniform rate than that of the Post-Cambrian. Drifts in the rocks of many other mining districts in later rocks fail rapidly when weight first shows.

In contrast to this, a cross-cut was driven 140 ft. in hard jasper in the Brotherton mine at Wakefield on the Gogebic Range early in 1913. In about two years this cross-cut had closed up until it was no longer visible. It contained not a stick of timber and no fall of ground occurred in it which could have caused a serious injury, yet it slowly closed up until it no longer existed. The closing was by slipping on the innumerable minute fault slips which register the stresses and deformation which have occurred during the long history since this rock was laid down. A similar closure of a long footwall drift timbered with steel sets took place at the Newport mine at Ironwood on the Gogebic.

Large-scale subsidence from deep workings has become an increasing subject of study and has profoundly affected operations on the Gogebic, Marquette, and Vermillion Ranges. The extent in the footwall and in the hangingwall of the subsidence is controlled by the various fracture systems, of which one is related to the bedding of the formation and two or three others are oblique to the bedding at varying angles. Subsidence in the two directions toward foot and hanging takes place on a sort of

resultant between these fracture systems. Again it is apparent that the geological history of the formation has etched its mark indelibly upon it and controls its response to the changed conditions brought about by mining.

The geologic history of a formation from the beginning is of overwhelming importance in determining its availability for beneficiation. The first beneficiation of Lake Superior ores of importance was the washing of western Mesabi sandy ores. These ores for the most part result from the oxidation and partial leaching of granular cherts. If the leaching has gone far enough to separate the original granules in the chert, the ore can be washed, if its iron content is high enough to justify the expense. Formation of the same analysis, in which the chert granules have not been sufficiently leached to be separated, cannot be washed without crushing it so fine that the expense would not be justified by the return. This again is a matter of geologic history controlling the utilization of ore.

The conditions under which manganiferous ores have been formed and leached and oxidized have a profound effect upon their present character, which is registered in the difference between the massive, hard, low-moisture, manganiferous ores of the Upper Huronian in Iron County and the soft, yellow-brown, manganiferous ores of the Cuyuna. The former contain Braunite and Hausmannite, the latter largely psilomelane. Some of the latter need drying before they can be profitably shipped, and sintering is being tried as a further beneficiation. The mining of the manganiferous ores of Iron County is mainly a problem in the cheap breaking of hard and tough material.

The concentration, commercially unprofitable, but technologically successful, of the eastern Mesabi iron formation at Babbitt, depended on the magnetic character of the formation, which in turn resulted from its induration by the Duluth gabbro.

Thus instances may be multiplied indefinitely of the intimate relationship between the geologic past of an ore formation and its mining and subsequent utilization.

Exploration.—The evidence is that future exploration will not be as easy

as in the past. The Marquette iron formations are magnetic and their hardness led to wide exposure which facilitated their rapid and early exploration by cheap test pits and trenches.

The eastern Menominee iron formation is magnetic, simple in outline, and outcropped in many places on high hill slopes. The Vermillion iron formation is highly magnetic and all the great mines had shallow cover. In all these districts the dip needle and the test pitter, with moderate assistance from the diamond drill, early led the explorer and the geologist to nearly all of the great mines of the present or past.

The Gogebic Range, which in its productive area is not so magnetic as the other ranges named, had nevertheless exposures in hill slopes, bluffs, and river valleys which neighboring magnetic horizons enabled the geologist to thread together so effectively that only one material change in the outline of the outcrop of the iron formation has been made since the seventies, this being the Ramsay-Wakefield fault trough structure which, lying south of the main range, carries the ore body of the Wakefield and Plymouth open pits.

The Mesabi, like the Gogebic, is feebly magnetic in its productive area. Its eastern end was early known, where the Duluth gabbro had thoroughly case-hardened it beyond commercial use. The rest of the range was followed by comparatively weak magnetic horizons in and near the formation, and by the outcrop of the Giant's Range granite.

The Cuyuna Range was entirely hidden by glacial drift, and was only discovered by drilling on local magnetic attractions occurring especially in the folded areas where local stresses have developed magnetite-grunerite schists along the fold axes. The position of the Cuyuna Range was forecast by Leith in his Mesabi monograph for the United States Geological Survey, reasoning from broad regional data only.

The Upper Huronian iron formations of the western Menominee are but feebly magnetic, their enclosing slates near the contact having stronger magnetic characteristics than the iron formation itself. They were originally found exposed in a few places on the flanks of river valleys, either present or pre-glacial. Exploration spread out from these places

mostly by diamond drilling, with such guidance as could be obtained from the weakly and irregularly magnetic wall rocks, from topographic features, from structures deduced from the outlines and occasional schistosity of neighboring formations and from regional correlation by means of outcropping hard rocks belonging far above and far below the iron formation. The first geologist to attack the problem of these formations was Pumpelly, who confessed himself as frankly bewildered by their complexity. Rominger worked out the local structures and succession at Crystal Falls and Florence, and correctly correlated these formations with the Upper Huronian formation of the Marquette and with the Taylor mine in Baraga County. He stated that the Upper Huronian slates (called by him the "arenaceous slate series") carry undoubtedly a vast amount of undiscovered iron formation with high phosphorus ores lower in iron than the standard high-grade ores of those days.

Further work has carried local structure into great detail. As the intricacies of the Iron River district were first drilled up, the complicated relations of slate and iron formation led to the belief that the latter occurred as disconnected lenses in the slate. Further work, including much underground structure and the detailed mapping of the entire district, has shown that all the high-phosphorus ores of Iron and Florence Counties, with the probable exception of one mine, lie in a single continuous iron formation whose thickness ranges from about 600 ft., at the narrowest, in Florence County, to over twice that in most of Iron County. Leith pointed out many years ago that the association with abundant graphitic, pyritic, black slate was a condition highly favorable to this type of ore. This, with the knowledge that the black slate is mainly in the footwall, and that intense folding is necessary to good ore concentration, in this formation, remains the chief key to Upper Huronian exploration. A thin black slate footwall and a straight, unfolded altitude of the formation, are the chief contra-indications in exploration of the Upper Huronian.

It still seems reasonable to predict, with Rominger, that whoever or whatever may ultimately unravel the intricacies of the great Upper Huronian slate series will throw large tonnages of high-phosphorus ores open to discovery. Locally and in detail in certain mines and small districts, the situation is in hand and by way of being solved. The large scale answer to the problem remains an intriguing and as yet unsolved enigma.

Geophysical Methods.—The recent intense interest in, and rapid development of, geophysical methods has not been overlooked in the Lake Superior district. No methods have yet produced in the Pre-Cambrian the dramatically successful results achieved by seismic and gravitational methods in the oil fields. In the Pre-Cambrian virtually all rocks are in the "high-speed" type of the seismic investigator and in the "heavy" type of the torsion balance expert. Differences undoubtedly exist, but they are not so radical as those traced in the oil regions.

Electrical conductivity methods have offered some promise, as in the magnetic and specular iron formations, but the common dip needle will more easily trace most of these. In the Lake Superior cop-

per rocks electrical conductivity has shown promise of usefulness.

The pyritic graphitic slate footwall of the Upper Huronian shows a marked conductivity, which has been tested by artificial current methods. It has also shown response to the Radiore method, which depends upon the local warping of the plane of transmission of radio waves in the neighborhood of a conductor.

This same black slate shows "self-potential," or naturally generated ground currents from the weathering of the pyrite in contact with graphite. These currents, usually read on a milli-voltmeter, have occasionally been found up to a volt, enough to light a flashlight bulb.

Torsion balance gravity methods have been tried, but have offered slight reward, due to irregular terrain, small difference in specific gravity of most rocks, and the consequent slow progress and large number of set-ups needed, together with the large assumptions which have to be made in correcting the readings for inequality of terrain.

The major results have been obtained from the ancient and first known geophysical method, magnetic observation. The dip needle, the Hotchkiss super-dip, and the vertical type of magnetometer have been the chief instruments used. The first is the fastest but least sensitive, and its possibilities were pretty fully realized upon for the entire district many years ago. The iron formations capable of being traced with a common dip needle have nearly all been traced, and many of them have been found to pass off into obscurity due to the limitations of this instrument. The magnetometer is the most consistent and accurate of the three instruments, and offers the most elegant solution of magnetic problems. It is a fragile instrument and difficult to get much speed with. The Hotchkiss super-dip is about twice as fast as the magnetometer, can be adjusted to a wide range of sensitivity, is very rugged in operation, and for most purposes gives as satisfactory a magnetic profile as the magnetometer.

Oxidized but non-specular iron formation reflects its presence by a broad, smooth sag in the magnetic profile across the formation which is discernible only where high sensitivity is used on the instruments. Unoxidized iron formation yields a relatively high and, if the cover be not too deep, a sharply serrated profile. The specular formations yield high profiles which usually show the dip of the formation very clearly. Soft ore bodies often produce sharp local sags in the magnetic profile.

When the next surge of exploration activity comes, the supersensitive magnetic instruments will undoubtedly play an important role, and one which there is reason to believe will be fruitful.

Some General Considerations.—Looked at broadly, igneous intrusion and metamorphism of the whole Pre-Keweenaw series increases from south to north throughout the Lake Superior region. By the time the Canadian line is reached the iron formations are nearly all metamorphosed almost beyond recognition. The old Helen mine, on the Michipicoten, is the only Lake Superior iron mine where material tonnage of standard iron ore was produced on the Canadian side

of the boundary. Roasting of carbonates at some points and magnetic concentration at others has produced successfully from a technological, if not from a commercial standpoint, small tonnages of iron ore elsewhere in the Canadian Lake Superior region.

At the same time, mineralization of directly igneous origin is abundant on the Canadian side in the entire Pre-Cambrian and almost missing on the United States side in everything older than the Keweenaw. A limited area north of the Marquette range offers some gold possibilities. A somewhat similar area on the Vermillion has shown lesser traces of gold. Some rude explorations for silver and lead were tried in the Gogebic area in early days with negative results. Otherwise directly igneous ores are completely wanting in the Pre-Keweenaw of the Lake Superior region in the United States, as far as known.

This condition suggests that the very igneous action which has developed the large variety and wealth of igneous vein deposits on the Canadian side has rendered the Canadian iron formations largely metamorphic and unproductive; while the absence of such intense igneous activity on the United States side of the line has left the iron formations more generally amenable to surface weathering and concentrating agencies.

Summary and Conclusions.—There are two Huronian iron-bearing members in the Lake Superior region, of which the lower one, of Middle Huronian age, is overwhelmingly the larger and higher grade producer. The Upper Huronian iron formation produces the high phosphorus ores and most of the manganese ores.

The Vermillion range is currently believed by the overwhelming consensus of opinion to be Keewatin in age. It was in early days classed as Huronian. For reasons stated, the writer believes the early classification may have been right, and should be checked by radio-active methods, which may prove it to be Middle Huronian.

Natural concentration of iron ores in the Lake Superior region has been by surface weathering, oxidation, and leaching on the present, or basal Cambrian land surface, and on various vanished, tilted and folded Pre-Cambrian terrains. Specularization where found reflects the subsequent metamorphism by diastrophism, or folding and intrusion, of iron formation or ore which had previously been oxidized from the original carbonate formation. Specularization is confined to Pre-Upper Huronian formations. Diastrophism changes unoxidized carbonate iron formations to magnetite-grunerite schists, wholly impervious to further concentration agencies.

Igneous intrusion is therefore the implacable foe of ore concentration wherever it is sufficiently intense to metamorphose a carbonate formation. Igneous intrusion assists concentration, where it has not produced metamorphic action sufficiently intense to case-harden the formation, and where the intrusions are so related to the attitude of the formation as to produce structural troughs for the localization and concentration of downward moving ground waters. Igneous intrusion of intensely metamorphosing magnitude changes soft ores to hard ores with accompanying compacting and

(Concluded on page 42)



Of All Things . . .

J. P. Morgan made a "hit" with the Senators conducting the munitions investigation who questioned him. . . . But he made a greater "hit" with the elevator boys who whisked him to the third floor hearing room and the capitol police. . . . His last day he unobtrusively distributed \$10 bills to more than a dozen. . . . The Senators don't know it yet. . . . There would probably be an investigation. . . .

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A good many Senators and Congressmen have proposed bills which would require a 7-to-2 decision by the Supreme Court. . . . No one ever heard them advocate that a 7-to-2 majority be required for election of Senators and Congressmen.

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The "wildest" anti-Supreme Court bill introduced was that by Rep. Monaghan, of Montana, which would have automatically declared vacant the seats of Supreme Court justices who held against the TVA. . . . The bill was withdrawn after the TVA decision was handed down. . . .

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It costs the Senate and House \$7,500 a month during the session for page hire. . . . These are the little boys who run errands for the members of Congress. . . . They must be over 12 years of age and under 18. . . . Each receives \$4 a day. . . .

~~~~~

In addition to 54 doorkeepers and other flunkies whose annual salary totals \$130,000, the Senate itself also maintains one upholsterer and locksmith who receives \$2,400 annually, one cabinetmaker, three carpenters, and one special janitor who each receive \$2,040 annually, and one clerk who guards the Senators' private passage from the floor to the Senate chamber at \$1,680 annually. . . . Who says it isn't nice to be a Senator? . . .

~~~~~

The new Senator Long is fast becoming the most popular woman at the Capitol. . . . Shrewd observers believe that in addition to her own charm the fact that her late husband's Share-the-Wealth followers weren't very liberal about sharing the votes down in Louisiana with the Administration makes her even more popular. . . .

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Congressmen can still hire horses if the hire is connected with the performance of their legislative duties. . . . The only provision is that the contract must include cost of feeding and stabling the animal. . . . The House of Representatives will absolutely not be liable for stable keep or forage. . . . It's an old law of 1885 still on the statute books. . . .

Senators and Congressmen are provided for, even after death. . . . If their families decide to bury them in the Congressional cemetery, taxpayers must pay the cost of a suitable monument erected over the grave. . . . The only restriction on the monument is that it must be of granite. No limit is placed on the cost. . . . A law enacted 70 years ago takes care of this matter. . . .

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For those in charge of the President's new tax program on Capitol Hill, it's a difficult job to see eye to eye with the President. . . . Some of them complain they are getting cross-eyed. . . .

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Politicians make no secret of the fact that they believe recovery is here. . . . But they haven't mentioned that January unemployment figures increased 1,200,000 . . . the worst January in five years! . . .

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Right now a search is on for political speech writers. . . . Most people think that the speeches are funnier when the humor is unpremeditated. . . .

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You'd think the unusual cold weather with sharp drops in temperature that Washington has experienced lately would bother New Dealers. . . . Not a bit of it. . . . They're acclimated to the freezing Supreme Court decisions. . . .

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Despite the expressions of amazement by Congressmen at the President's tax message, the leaders are secretly pleased. . . . There was a week of juggling back and forth as to who would "take the rap" for taxes in an election year. . . . The President took it. . . . Now even his bitterest foes agree that the program offered is "water-tight politically." . . . Corporations aren't heavy voters is the answer to the tax program "suggested" and confidently expected to be enacted. . . .

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The President's tax message came just when the Treasury announced that the deficit at the end of eight months of the fiscal year stood at two and one-half billions; the public debt at thirty and one-half billions . . . a new all-time high. . . .

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Despite the talk about the emergency being over, Government expenditures don't show it. . . . Total recovery and relief expenditures for the first eight months of the present fiscal year were \$2,216,350,399 . . . just \$101,000,000 less than for the same period a year ago. . . . In these days \$101,000,000 isn't much to brag about. . . .





# Wheels of Government . . .

**J**UDGING by the way the supply bills are being snapped through in recent weeks there no longer remains any question that both the leaders and the rank and file of the National Congress intend to get out of Washington at as early a date as is possible. All of the supply or appropriation bills, Independent Offices, Supplemental Deficiency, Interior Department, Treasury and Post Office, War Department, and Agriculture Department are either enacted or well on their way in the Senate. Those remaining which have not as yet been reported in the House are District of Columbia, State, Justice, Commerce and Labor, Navy Department and Legislative. Of the legislative bills we have as enactments the Compensation Payment Act; Repeal Tobacco, Cotton, Potato Act; Extension of Neutrality Act and Conservation of Soil Resources.

Still remaining, and of major importance, is the Revenue Act of 1936 which can develop into a controversial and long drawn out procedure. This can be especially true if the Congress follows the announced intention of the President to procure over a billion dollars of additional revenue. It is well known that congressional leaders and many members of Congress are opposed to any such enormous tax assessments. A fair cross-section of their desire indicates a will-

ingness to secure additional revenues, to the extent of perhaps \$600,000,000, through processing and excise levies and possibly through some further squeezing of corporate business enterprise. At this time the feeling prevails that the bill can be handled with almost the same degree of dispatch as the supply bills, and it is thought that May 1-10 will see the Congress adjourn.

In so far as the present session is concerned the Black-Connery 30-hour week bills are felt to be out of the picture. Representative Connery has so indicated and has further stated that the 1937 session of the Congress will see the enactment of such a measure. The Neutrality Resolution, extending for one year the original resolution of August 31, 1935, was approved by the President February 29 as passed by the House. It provides by amendment an embargo against purchase, sale or exchange of securities for belligerent countries except an American republic or republics engaged in war against a non-American state or states. The amendment further changes the wording of the original resolution by striking out "that upon the outbreak or during the progress of war between" and substitutes the words "whenever the President shall find that there exists a state of war between."

The Robinson-Patman-Utterback price differential bills have been the object of effort and action in the past month. Simultaneous with the reporting of the Robinson bill in the Senate on February

3 (without hearings) came the hearing on the Utterback bill before a subcommittee of the Committee on Judiciary in the House. The American Mining Congress made appearance at this hearing and filed a statement asking that minerals and metals be exempt from the proposed amendment to section 2 of the Clayton Act. The amendment suggested reads as follows:

*"Nothing in this section 2 contained shall prevent the sale or purchase of crude mineral products or metals in the form in which they are loaded for shipment at prices or terms of sale based upon differences in the grade, quality, or quantity of such products, or that make only due allowance for differences in the cost of selling or transportation, or discrimination in the price of such products in the same or different communities made in good faith to meet competition."*

In the factual statement embodied in the brief it was argued that the sale of the products of mines at retail is negligible; that the mining industry neither sends to or purchases from chain stores. The situation of mining and the marketing of mining products was further set forth as follows:

*"The products of mines are peculiarly susceptible of sales arrangements covering large quantities and long term contracts. Virtually all minerals and metals are in the first instance bulk basic raw materials, sold in large quantities and not sus-*

ceptible of general retail distribution. Some retain their characteristics as a basic raw material up to the stage where they have undergone some processing. This has been borne in mind in the form and language of the suggested amendment, which would apply to minerals and metals in the form in which they are loaded for shipment, for it is usually up to the point of shipment that minerals or metals retain their crude character."

The Utterback bill is still in the subcommittee and may remain there until the Robinson bill comes over from the Senate. On the Senate side the amendment to exempt mineral producers has been introduced by Senator King (Dem., Utah), and it is to be hoped that it will be embodied in the bill if and when passed.

After announcement by Representative Mansfield (Dem., Tex.) that his stream pollution bill would not be presented for enactment at this session, hearings were called for February 26 on Senator Loneragan's (Dem., Conn.) pollution of navigable waters bill. The notice given to industries and others affected was so short that upon representations made to Chairman of the Commerce Subcommittee Hattie W. Caraway (Dem., Ark.) the hearings were recessed to March 23. It is not anticipated that there will be enactment of the stream pollution bills at this session, but it is deemed important that the position of the industries affected be clearly set forth in order that the executive departments and the National Resources Committee studying this problem may be informed as to the serious hindrances involved.

The Walsh Government contracts bill passed the Senate last year and is in the Committee on the Judiciary of the House of Representatives. It has been under consideration by a subcommittee under the chairmanship of Representative Arthur D. Healey (Dem., Mass.). The bill

has been rewritten as H. R. 11554 and as such was introduced by Mr. Healey on March 2 with hearings set before his subcommittee on March 16. As rewritten, the administration of the bill is still under the Department of Labor, and it is a permanent measure. It affects sub-contractors by prohibiting "bid broker-

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While leaders remain non-committal, reliable reports are heard that active steps are being taken to shorten the present session by reducing the amount of legislation to be considered. The step was initiated by Congressional leaders but has apparently found warm support on the part of the politically minded Administration leaders. Controversial legislation is not desired in an election year. It is also indicated that the President is not opposed to early adjournment if unforeseen difficulties do not intervene. Administration leaders who do not want to be quoted have indicated that with the farm legislation, a bill to partially defray its cost, extension of present neutrality legislation, the Administration-wanted ship subsidy and water carrier legislation, and possibly a price discrimination bill, the "must" program would be out of the way. This does not take into account several other bills which many believe will receive serious consideration but it is generally acknowledged that no legislation but that of major Administration importance will be allowed to stand in the way of shortening the session.—(From Weekly Bulletin, American Mining Congress.)

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age." The measure is so undesirable that it is believed that the full Committee on the Judiciary will refuse to report it although labor representatives have insisted they must have enactment at this session.

Appropriations for the Geological Survey and for the Bureau of Mines for the fiscal year 1937 as the bill passed the Senate stand respectively at \$2,827,817 and \$2,113,200. In the Bureau of Mines appropriations cuts approximating \$96,000 had been made by action of the House Committee in assigning funds to the construction of a milling and metallurgical

pilot plant at Boulder Dam in Nevada. As the bill passed the Senate, these amounts were restored, through action of Senator Pope (Dem., Idaho) and of a subcommittee of the Committee on Appropriations under the chairmanship of Senator Carl Hayden (Dem., Ariz.). The bill has yet to go to the Conference Committee for joint consideration of the restorations made by the Senate.

The Silicosis Resolution introduced by Representative Marcantonio (Rep., New York) has been reported in rewritten form by the Committee on Labor. It now provides for an investigation by a subcommittee of the Committee on Labor instead of by the Department of Labor, of silicosis conditions in mining and tunneling. The resolution is now in the Committee on Rules of the House and it is the intention of the Labor Subcommittee to ask for funds from the Committee on Accounts and Expenditures. In the meantime, the Secretary of Labor is moving toward the calling of a nationwide conference on silicosis to be held some time this spring. As a preliminary move the Secretary invited 30 representatives of industries, insurance companies, and public health departments to a meeting in Washington on February 26 and addressed the meeting, asking cooperation in the development of a national conference. A variety of viewpoints were presented and the matter will probably be the subject of a further discussion by the same group about the middle of March. It was the feeling of many of those present that the study and control of silicosis and tuberculosis in industry should be carried on through the Bureau of public health and the Bureau of Mines with the cooperation of the industries affected. Both Dr. R. R. Sayers, of the Bureau of Public Health, and Dr. John Wellington Finch, director of the United States Bureau of Mines, in testifying at the hearings before the House Committee on Labor,

stated that marked progress had been made by the mining industries and that both bureaus had received excellent cooperation from the managements of mining companies. It was also brought out that ordinary silicosis is not a disabling condition and that many men with such a condition have continued to work for many years.



# THE MINING INDUSTRY and ITS EMPLOYEES\*

**D**URING the last two or three years it is generally conceded that the trend in Federal Government legislation has been toward favoring the employes in every phase of industry and in turn placing many added responsibilities and, in some cases, burdens on the employer. This trend in legislation is evidenced by the passage of such bills as the National Labor Relations Act, the Guffey Coal Stabilization Act and other acts of similar nature, all of which provide for close scrutiny and control of the employer in his dealings with labor but fail to place responsibility on labor itself.

It might therefore be entirely proper to briefly review the progress and changes that have taken place during the last 30 or 40 years in the Mining Industry, and to endeavor to determine whether or not this continued attempt on the part of Congress to force added responsibilities and control on this industry is warranted, especially during a period when business conditions and the demand for its products and the prices obtainable therefor make profitable operation very difficult.

It requires no great strain on the memory to picture the conditions under which men worked at most mines in the late '90's and the early part of the present century. We can see the miner slowly trudging up the hill, dinner pail in hand and dressed for his day's work underground. On arrival at the mine he was given four or five candles or a cake of crude oil paraffin, oftentimes called "sunshine," which was to furnish him light for his 9 or 10-hour shift. On arrival at the working face he laboriously drilled his round by hand or with a heavy and inefficient machine drill. The broken ore was hand shovelled into a small mine car usually having a bent axle or a flat wheel and hand trammed to the shaft station. On completion of his shift he reached the surface dirty and oftentimes with wet clothing and shoes and in this condition went down the hill to his home. Here he probably took a bath in the family wash tub, changed his clothing, ate his supper and after enjoying a pipe or two while reading the daily paper went to bed.

Compare this picture with conditions at any well managed mining property today. We now see the miner chugging up the hill in a more or less modern automobile and probably bringing several of his fellow workmen with him. On reaching the mine he changes his clothes in an up-to-date steam heated dry house in which he has a locker or hanger for

his individual use. He then provides himself with a can of carbide for his lamp or straps on a storage battery for his electric cap lamp and is ready to begin his 8-hour shift. If the working place is any considerable distance from the dry house transportation thereto is generally furnished. After reaching the working face he puts in his round with a rapid cutting modern machine drill. The ore is loaded, oftentimes with a mechanical shovel, into roller bearing mine cars and these cars are hauled to the shaft station or ore bins by an electric locomotive. His work at the face is generally completed in about six and one-half or seven hours. On reaching the surface he removes his dirty wet clothing, finds it very convenient to take a shower bath and oftentimes takes a "sun bath" in the solarium. After changing to his street clothes he steps on the gas and goes home. After supper he is ready for a trip to the company clubroom to read the latest newspaper or magazine, bowl a game or two or play a game of pool. If he wishes he can go to a movie to see and hear his favorite star, or settle down for a quiet evening at home with his radio and Amos and Andy.

It is, of course, true that many of these advantages that are now enjoyed by the employes are due to the progress that has been made during the past half century and to improvements in mining machinery, tools and equipment. However, modern mine managements have been quick to adopt new methods or equipment and fully realize that better working conditions for employes are highly desirable. They have also shown a willingness to use every effort and make every reasonable expenditure to keep mining abreast of the times and to improve conditions wherever possible.

The many problems of mine safety have received much attention during the last decade. No longer is this work turned over to the shift boss or foreman for such attention as he can find time to give it, but now engineers trained for this particular job are employed by many companies and every phase of mining receives careful attention. Efforts are

made to have all employes become "safety conscious" and they receive repeated warnings regarding unsafe working places or working practices. Crews of picked men are under continuous training in first aid and mine rescue work in the larger properties and in the Coeur d'Alene District a Central Mine Rescue Station is maintained with 150 trained helmet men available for call in case of a mine fire or other emergency.

In the case of injury, employes are given skilled hospital and doctors' attention if the case is of a serious nature and every effort is made to have every injury, no matter how slight, receive attention. Some companies maintain first aid rooms with a trained nurse in attendance while others depend on local doctors and hospitals. All of this attention is resulting in a lowering of the accident rate and in making a mine a better place in which to work. Compensation to injured employes is paid according to schedules provided for by state laws, but in serious cases no expense is spared in furnishing the best hospital and surgical attention obtainable. Medical attention is also often given to sick employes.

In the case of deep mines the ventilation problem is often a serious one and no efforts are being spared in improving air conditions in every way possible and large sums are expended annually on this work. Arrangements are also oftentimes made with the U. S. Bureau of Mines for their engineers to cooperate with the local managements and to make careful investigation of air conditions and suggest methods for improvement.

All of the larger companies are also concerned with the welfare of their employes and their families, and this interest is shown in many ways. Up-to-date clubrooms for employes are often found in many districts where one can enjoy reading rooms, with files of current newspapers and periodicals, and some form of athletic or other entertainment, such as bowling, pool, billiards, handball, basket ball, dances, radio, etc., is usually available. Some companies maintain night schools for employes, where courses

\*Presented at Annual Meeting, Idaho Mining Association, Boise, Idaho.

†General Manager, Federal Mining & Smelting Co., Wallace, Idaho.

in many subjects are to be had for the asking. One company I know has, at considerable cost, installed a solarium for the benefit not only of its employees but for their wives and families. Here "sun baths" can be had without cost, and the benefit of this to the health of the community in general has received much favorable comment. During the summer months swimming pools are maintained by some companies and outdoor athletics, such as baseball, tennis, etc., are encouraged and financially supported. Employees are also encouraged to own their own homes, and many companies provide easy payment plans for individuals who are steady workers and who desire to become property owners.

At some properties all employees are carried under a group life insurance plan, the amount of the benefit depending on the length of service and increasing therewith. This cost is borne entirely by the employer, and in many cases this money has saved a family from dire distress and want. Some companies have also established a pension plan for aged employees that have been employed regularly for many years.

Mining companies are vitally interested in the welfare of communities in which their plants are located and contribute freely to all civic work. During the height of the recent depression many companies operated their mines at a loss and wasted their output solely for the benefit of their employees during periods when other work was not obtainable and when a shutdown would have caused untold misery in the community. During this period substantial contributions were also made to local relief funds. In one case coming under my observation a whole community was organized under a company-directed plan for cutting firewood for winter use during a period when the plant was closed down. In other communities garden plots were given to employees, and seed furnished. In all cases no effort or expense was spared to relieve the existing distress due to nonemployment.

It may also be of interest to know that during the recent depression the wage scale of the major companies operating in the Coeur d'Alene district was always above the minimum provided for by the President's Reemployment Agreement or by the codes, and that voluntary increases were made from time to time in an effort to live up to the spirit of the new ideas of government. It is also a fact that although a complete shutdown of operations, with a corresponding conservation of their product, would have been advisable at certain times, most of the companies operated continuously, though on a somewhat curtailed schedule, and those forced to shut down did this during the summer months, when living conditions were most favorable.

Present conditions in most of the mining districts in this country are showing improvement, and with a continuation of the upturn in general business, mining will undoubtedly continue to expand and furnish increasing employment. Never-

theless, the demand for many of the base metals is still below normal, and many companies are now producing more than the market will absorb and are, consequently, finding it necessary to carry a part of their current production in stock. This procedure, although it greatly benefits present employment, cannot continue indefinitely, and any action having a tendency to increase the expense of mining can only serve to hasten the time when the breaking point will be reached.

Many of the points which I have mentioned so briefly would bear much elaboration. However, the record of this industry in its relations with its employees and with the community in general is one that will bear investigation and on which it can firmly stand. For many years the efforts of all progressive managements have been directed toward improvement in working conditions at their plants, and all of this is sure to result in closer cooperation between employer and employee, a better satisfied employee and a more efficient organization. The advance has been steady, and no one can deny that much has been accomplished even during a period of record low metal prices. It would, therefore, seem that the mining industry deserves some consideration, and that any Federal or state legislation that will have the effect of putting additional financial burdens or other hindrances on it can only have a detrimental effect, and that such legislation is both unwarranted and unnecessary.

● UPON invitation of the Secretary of Labor, a conference was held on February 26 attended by representatives of some 16 principal industries in which silicosis is believed to be a problem, of organized labor in such industries, casualty insurance companies, state health and industrial hygiene departments, safety associations, the U. S. Bureau of Mines and U. S. Public Health Service.

The purpose of the meeting was to consider possibilities of cooperative action in regard to silicosis and plans formulated by the Secretary of Labor for a series of large general conferences in Washington to discuss all phases of the silicosis problem.

Representatives of the various industries were asked to state what was being done with regard to silicosis. Called upon to discuss the situation in the mining industry, Julian D. Conover, Secretary, American Mining Congress, stated that the industry had been deeply interested in the matter for many years. He referred to the studies made in various mining districts of dust conditions and the means of preventing pulmonary trouble, and to the widespread adoption of preventive measures for allaying of dust and providing adequate ventilation and promotion of general hygiene. He referred particularly to the cooperation of the Bureau of Mines and Public Health Service in helping the industry

to solve its problems, and to the excellent progress which had been made through applying the recommendations of these agencies. Although ordinary silicosis does not produce disability, it is recognized that certain infectious diseases may be aggravated by silicosis and special care has been given to the eradication of such diseases.

Following statements by the various interests represented, the Secretary of Labor discussed the general problem of occupational disease, stating in part:

"Just as employer interest is the first requirement in accident prevention, so it is in the prevention of occupational diseases. The employer is the key to prevention of occupational disease working in cooperation with employees and government officials.

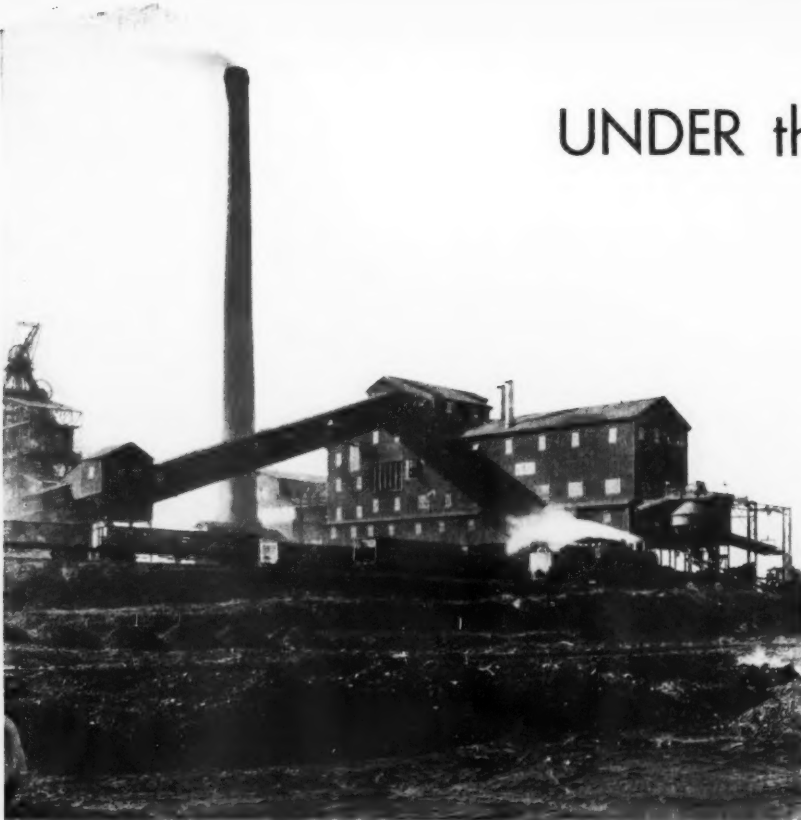
"Out of the coming conference I am hopeful there will come plans for concerted action against this serious industrial disease. Prevention is the first thought and first responsibility. Adjunct to it some way must be found of bringing the benefits of a workmen's compensation coverage to those disabled by the exposure in or arising out of their work that will afford reasonable benefits without imposing too great a burden upon production.

"Management has accomplished big things in accident and disease prevention in the past, and I am convinced that similar results can be obtained in the war on silicosis by the cooperative efforts of those who have knowledge and are responsible in relation to industry—employers, management, labor, insurance companies, government, technical societies, engineers and physicians."

It was stated by Miss Perkins and by Mr. V. A. Zimmer, head of the Division of Labor Standards of the Department of Labor that the proposed conferences would be held without "ballyhoo" and that the emphasis would be on preventive measures. It was explained also that the formulation of joint recommendations for more or less uniform compensation laws covering occupational diseases is an important part of the contemplated program. In discussing the plans for the conferences, many of those present, including representatives of both industry and labor, referred to the complicated nature of the silicosis problem and the lack of similarity between different industries which would make such a series of conferences of doubtful value. It is anticipated that a further meeting of the "steering committee" will be held in March for further consideration of the silicosis matter and the proposed action of the Department of Labor.—  
(From Weekly Bulletin American Mining Congress.)

# UNDER the SURFACE

By PAUL WEIR\*



*The Zeigler Cleaning Plant of the Bell and Zoller Coal & Mining Company*

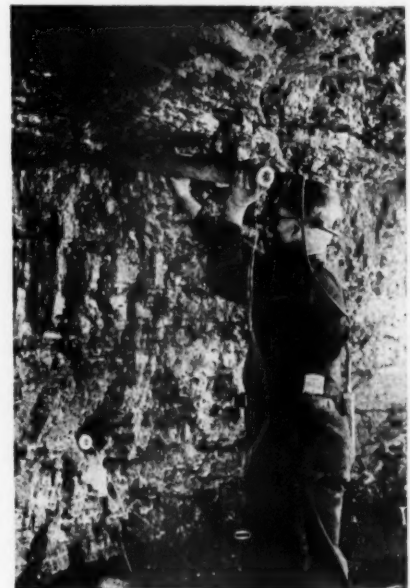
FOR the past three years, most of that which has been written and said concerning the bituminous coal industry has had to do with the application and effect of NRA's Coal Code and more recently the Guffey Coal Conservation Act. To many it might appear that these represent almost all that is happening in and to the industry. Such is not the case. At an ever increasing rate, mechanization and modernization of production and preparation are taking place. Changes are proceeding so rapidly that even those within the industry are constantly confronted with the necessity for revising their own ideas of what constitutes the best practices in organization, methods and machines. Very definitely, the competition of natural gas and petroleum products is challenging the resourcefulness of producers of bituminous coal. They must give to purchasers of fuel an acceptable grade of coal at a price which results in a greater number of effective heat units per dollar expended than can be had with any other fuel. At the same time they must pay a substantial wage to employees and return a reasonable profit to investors after paying the constantly increasing tax bill. Men who have devoted their lives to the extraction of mineral products from the earth's crust are, because of the very nature of their employment, extremely resourceful. This resourceful-

\* Vice President, Bell & Zoller Coal & Mining Company.

ness can be depended upon to meet any equitable challenge of other fuels by means of mechanization and modernization, a combination of which will bring to consumers of coal, a better product at a cheaper price.

Just a decade ago, the loading of coal underground by machines was in an experimental stage. A few machines were being tried out by hardy and ambitious operators with indifferent success. The judgment of the majority of mining men was that the loading machine would probably be perfected at some distant date, but that for some years to come could not be profitably substituted for a number two shovel in the hands of a strong miner. Strip pit mining in Indiana and Illinois was being practiced on a small scale with overburden shovels having a dipper capacity of approximately 8 cu. yds. The engineering and technical staffs of coal companies consisted largely of a limited number of men whose chief duty was surveying on the surface and underground. The supervisory forces were recruited almost entirely from the ranks of miners and consisted of those outstanding practical men who had gained some technical knowledge by tedious night study after working underground during the day. The miners themselves were men who had learned from their fathers the expert use of a pick, the trick of hand shoveling, the use of explosives, the placing of timbers for

support of the roof and the laying of track for transportation. Each miner performed these many individual operations during his day's work. Mechanical cleaning of coal in Indiana and Illinois was limited to several not too modern plants of relatively small capacity. The



*Shot-firer Loading Holes with Cardox*

coarse sizes of coal at some mines were being hand picked. At others, the only cleaning of coal was being done underground by the miner. While some mines did have efficient screening plants, others had practically none. Few, if any operators were willing to listen to requirements of buyers for special sizes and preparation. The smugness of the post-war period had not been erased. Only a very few combustion engineers were on the payrolls of coal companies. Such was the picture only ten years ago.

A phenomenal change has taken place during this decade in men, methods and machines. Production by hand methods in Indiana and Illinois has been steadily supplanted by mechanical methods until in 1935, 70 percent of the total annual production came from mines which had been mechanized. Mass production, as spoken of in manufacturing industries, is being applied to the mining of coal. The experimental underground loading machine of ten years ago has been developed into an efficient unit capable of loading four to five hundred tons per shift. In strip mining, the size of overburden shovels has jumped to those having dipper capacities of 32 cu. yds. Accompanying this has been the necessary development of all accessory equipment such as undercutting machines, drills, locomotives and mine cars. With mechanical methods of loading and because of ever increasing freight rates, together with consumer demand for a better product, has come the need for improving the preparation. It is logical that mechanical cleaning go hand in hand with mechanical loading.

Attempting to clean by manual means that which is loaded mechanically is costly and inefficient. The daily capacity of mechanical cleaning plants or washeries in these two states has grown from practically nothing in 1925 to the imposing total of 42,000 tons at the end of 1935.

With the great changes in equipment has come just as great changes in methods and organization. While the old time miner was skilled in many things, today the miner is trained to do expertly one of the many things which he formerly did. He is a driller, a shooter, an operator of a loading machine, an operator of a cutting machine or of one of the many other mechanical and electrical devices. He works on the "assembly line." Many of the mine superintendents are now technically trained. The engineering and technical staffs of progressive companies have been greatly expanded and now commonly include civil, mining, electrical, combustion and mechanical engineers. Less common but in-

creasingly important are preparation engineers, chemists and industrial engineers. The traditional ways of our grandfathers carry less and less influence on present day methods. The tendency now is to seek out facts and to pursue a course of action based on proper engineering instead of hacking away by rule of thumb. While research work is still closely confined to institutions having the necessary staffs and equipment, more and more are coal producers attempting to apply this academic knowledge to their every day problems.

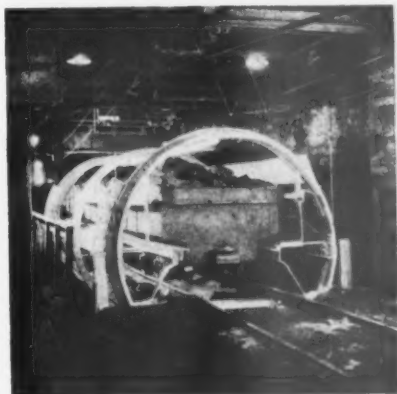
During this 10-year period, in the mines of Indiana and Illinois alone, there has been spent on modernization of equipment the imposing sum of approximately \$40,000,000. A further sum of approximately \$8,000,000 has been spent on new mechanical cleaning and washing plants. These expenditures evidence the fact that coal operators are not leaning too heavily upon miracles to save themselves from being eliminated as purveyors of fuel.

We marvel at progress in the automotive industry. Our 1936 car evidences the ingenuity and resourcefulness of automotive engineers. Changes in methods



of production of bituminous coal are just as marked as changes which have taken place during the past 25 years in the production of automobiles. Few coal mines are now "holes in the ground" or "holes in the side of a hill." Rather they have become more or less industrial establishments with the problems of a factory addition to the problems inherent to the extraction of minerals.

The purchasers of fuel may well study the progress of the coal industry during the past decade. While coal's problems are momentous, there is every reason to believe that those problems can and will be solved. The next decade will bring even greater developments in production methods and equipment. As these developments come, the purchaser of fuel will benefit.



*Left — Rotary dump on the bottom of Zeigler No. 1 Mine Shaft*

*Below — The 32-yard shovel of the Binkley Coal Company at its new Bob-o-link mine in Indiana*



# LUMP INCREASED 83% with AIRDOX at KINGS MINE

By P. R. PAULICK\*

**D**URING the evolution of coal mining from the old-time pick mining methods to the present efficient mobile machine, the sizing and grading of coal has been instituted to give the consumer his fuel in the form found most usable and economical. This has to a certain extent created a kick-back because the size of coal now has placed upon it a distinct element of value which is far out of proportion to the energy value in the respective size. Each different size has its use and also its price, and it seems that the larger the size the higher the price. Like all progressive producing and distributing concerns, the Princeton Mining Company began to closely size and prepare its product on the surface and now has facilities to make the following sizes or combinations thereof: 6-in. lump, 3-in. lump, 6 by 3-in. egg, 3 by 2-in. egg, 2 by 1½-in. nut, 1¼ by ¾-in. stoker, 2-in. screenings, 1¼-in. screenings, mine run washed stoker, and dust.

Because the policy of the management of the Princeton Mining Company always has been to handle only the best product and to do business on a quality basis only, wholesale and retail markets have been developed with this thought predominating. It was therefore natural that the management was on the lookout to get the best coal seam available in which to concentrate their mining operations. The Kings mine of the Princeton Mining Company is located in Gibson County, Ind. It has been in operation since 1923, and was developed from scratch, nearly a year being spent in drilling and prospecting operations before the projection was finally opened for production. It is the deepest mine in the state, depth of the hoist shaft being 450 ft. The coal mined is the No. 5 seam, which has been correlated with No. 5 seam in Illinois and No. 9 in Kentucky. In Indiana the seam varies in thickness from 6 to 9 ft., and at Kings mine, 6 to 8 ft., averaging 7 ft. Like all coal seams in the eastern half of the continent, this coal was formed in the carboniferous period and belongs to the Pennsylvania group Allegheny series of coal-bearing measures. Immediately over the coal, forming the working roof of the mine, lies a black shale 3 to 10 ft. thick, containing many fossils of fish fins, ferns, and other fauna belonging to that age. Overlying the black shale

is a 4 to 6-ft. layer of limestone, sometimes called the "steel band," containing many fossils of gastropods, sea shells, and other forms of low animal life found in that period. On top of this to the surface is an assortment of limestones, sandstones, shales, etc., similar to overburden found in other coal fields. No. 5 seam is a solid bed, does not contain any refuse partings, but it does contain many pyritic concretions, especially the upper 18 to 24 in. of the seam, causing much difficulty in drilling the coal.

The system of mining used at the Kings mine is of the familiar room and pillar type. However, no pillars are recovered, these being left in to help sustain the overburden overlying the coal. Therefore, a system must be used by which the greatest percentage of recovery is made consistent with the proper preservation of the surface. At the present time two sections, or parts, of the mine are worked, Main South and Main Southwest. Off these two main entries cross entries are driven, off which in turn are driven the room or producing entries. These producing entries are of such length to accommodate a set of 20 rooms on each side; rooms are driven on 44-ft. centers and are 26 ft. wide. Ten rooms are assigned to a mechanical loading unit as a section,

and two units are placed on one producing entry, thus concentrating the work of recovery, simplifying the gathering and main haulage, supervision, etc. Main and producing entries are driven four abreast. This is done for the purpose of carrying sufficient air for ventilation and to give the developing units enough places in which to work efficiently. Between the upper and lower set of 10 rooms the producing entries are cut down to two for a distance of 56 ft. This leaves a supporting solid pillar of coal between the upper and lower set of 10 rooms and enables the 10 rooms being sealed off when finished, and helps to support the overlying strata and keep it from squeezing over while the lower 10 rooms are being worked.

Natural mining conditions found at this mine are average for the state of Indiana. However, conditions found here would be classed as very good in other states, notably Pennsylvania and Ohio. Track is of the best; the main line haulage is laid with 60-lb. rails on 6 by 8-in. treated ties, ballasted. In room entries and rooms, 30-lb. rails are used, laid on 3 by 5-in. untreated ties, and on steel ties where the coal is 6 ft. or less in height. A feature at this mine is the fact that only round posts are used which cannot be less than 5 in. in



*Property of the Princeton Mining Company*

\* Engineer, Princeton Mining Co., Princeton, Ind.

diameter at the small end. It has been found convenient and economical to use two sizes, 7 ft. and 8 ft., because of the variation in coal height from 6 to 8 ft., incidentally there being a differential of 3 cents per post between the 7-ft. and 8-ft. size.

Three main factors were responsible for the management's decision to experiment with the air method of dislodging coal. First, the management's policy of selling or handling only the best obtainable product demanded by the consuming trade. Now it is particularly true in the Middle West that lump coal—good lump coal—is demanded and a premium paid for it in the winter months, and in the summer months small coal is accepted. It has been proven theoretically that air-shot coal produces more and better lump than powder-shot, the air-shot coal being harder, of firmer texture, handles better in loading, stands up better in transit, etc. A second factor affecting the decision to experiment with air shooting is a state statute prohibiting shooting of coal when men are in the mine. This statute works a hardship on the operating company, in that a larger territory must be maintained for a certain production than would be necessary if shooting were carried on during the mining process. Excess material is tied up in the larger territories, which must be kept open for a set production. Still another factor is the inherent safety feature of the air shooter. It is generally true that all coal seams liberate the occluded gases trapped in the coal pores during the process of coal formation. Some seams, near the surface with shallow cover, do not exclude enough gas to be harmful; other seams, especially seams having heavy overburden, exclude gas in such quantities that become dangerous unless extreme care is exercised. Therefore, a potential hazard, is always present. Especially is this true when explosives are used for blasting the coal. Manifestly the three enumerated factors

were enough to convince the management that the air method of dislodging coal rated a trial, and a unit was received on October 1, 1934, on a 60-day trial period basis.

Before explaining the experiment in detail, perhaps it would be well to pause and make a brief description of the airdox unit. It is a self-contained unit mounted on a self-propelling truck for mobility and flexibility. Compressor is of the four-stage type single-acting "V" type, the original unit being water cooled; but all our present models (we have a total of three) are entirely air cooled. Advantages of air-cooling machinery over water-cooling in a coal mine are readily apparent. The compressed air from each stage passes through a copper cooling coil before entering the next succeeding stage. In actual operation, the air enters the compressor through an air cleaner located on the upper side of the first stage cylinder head, passes through the inlet valve, and is compressed by the first stage piston to 70 lbs. per sq. in. It is then discharged through the discharge valve and passed through the first cooling coil, which, as said before, was water cooled in the first unit but now is air cooled. The cooled air then flows through the piping to the air inlet of the second stage cylinder. Here the air is compressed to 400 lbs. and passes to the second stage cooling coil, is cooled, and flows into the third stage cylinder, where it is compressed to 1,800 lbs. After being passed through the third stage cooling coil, the air enters the fourth, and last, stage cylinder, where it is compressed to any desired pressure up to 12,500 lbs. per sq. in., that being the maximum capacity of our present units.

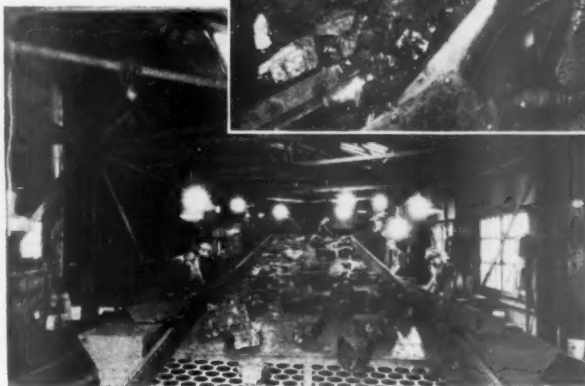


From the fourth stage, the air passes to the outlet manifold, where it is discharged into the  $\frac{3}{4}$ -in. copper tubing leading to the air cartridge, or shell, in which it is stored to the desired pressure preparatory to being discharged. This air cartridge, or shell, is essentially a hollow steel shell 4 in. in diameter, varying in length from 52 to 62 in., depending upon its volumetric capacity which ranges from 260 cu. in. to 325 cu. in. The 260-cu. in. shell was the one originally used in our experiment, however, it was found inadequate and has been replaced by the present 325-cu. in. shell. We have found that the 325-cu. in. shell gives the best performance in dislodging the coal, squaring up the face, and obtaining the maximum amount of lump. The actual operation of dislodging the coal with airdox consists of placing the shell in a  $4\frac{1}{4}$ -in. diameter hole, pumping up the shell to the desired pressure and discharging it through a lever arrangement located on the truck. When shooting coal with powder four holes  $2\frac{1}{4}$  in. in diameter were used to dislodge the coal face in a 26-ft. room. With airdox twice as many holes are required and the diameter is nearly twice as large or  $4\frac{1}{4}$  in.

In actual practice two men are required to operate each airdox unit, the compressor operator, and the face man. The face man does all the handling of the shell placing it into the proper hole, makes his estimate of the pressure required which he then signals to his buddy. The compressor operator starts pumping the shell through the  $\frac{3}{4}$ -in. copper tubing to the estimated pressure. In ordinary room work 50 to 75 ft. of tubing is used. When the desired pressure is obtained, which takes from 1.25 to 2.00 minutes, the compressor man dis-



Views of  
Mechanical  
Loading and  
Picking  
Table



charges the shell through the "blow down" valve located on the front end of the truck and actuated by a lever conveniently placed for the operator. The operation is repeated until all 8 holes are shot.

On October 1, 1934, an airdox unit was obtained from the Sullivan Machinery Company on a 60-day trial basis. It was agreed that during this trial period full and complete records would be kept and detailed time studies made on all phases of the work affected by the air shooting; loading operation, drilling operation, and shooting operation. Because the results obtained during the first part of the experiment were not entirely satisfactory an extension of 30 days was obtained and experiment continued. During the experiment pressures ranging from 7,500 to 11,000 lbs. per sq. in. were used. All the following production and performance data are based on detailed time studies rather than on actual production records. The reason is obvious for the actual production records are always marred by delays, breakdowns, slow men, etc., which affect the production of different units in varying degrees depending upon the machinery and type of men used. On the other hand results based on time studies take into account all these factors and show a true picture of the operation uninfluenced by fluctuating items.

The resultant important advantages and disadvantages due to using the air-shooter in rooms are shown below. They are also shown in tabular form with monetary values calculated for each item.

#### Advantages

1. Increases 6-in. lump percentage (also quality) from 10.09 percent to 18.45 percent or an 83 percent increase; thus increasing sales realization by .0846 per ton. Other sizes are decreased.
2. Eliminates the use and handling of powder which amounts to \$15.31 per day.

#### Disadvantages

1. Drilling is increased and more difficult, 8 holes are required per cut with air shooting, with powder shooting 4 holes were required. Diameter of holes is increased from 2½ in. to 4¼ in.
2. Adds two additional men for shooting. One airdox unit will shoot coal for two 5 BU Joys but only for one 10 BU or 11 BU Joy.
3. Decreases loaders capacity 3 percent.
4. Adds another machine to section causing additional conflict when moving machinery.

#### DAILY COST IN FAVOR OF

| Item                                  | Air shooting | Powder shooting |
|---------------------------------------|--------------|-----------------|
| Cost of powder .....                  | \$15.31      | ....            |
| Increased sales realization.....      | 53.30        | ....            |
| Depreciation of air shooter.....      | ....         | 13.11           |
| Depreciation of larger drill.....     | ....         | .50             |
| Cost of drill bits.....               | .11          | .50             |
| Maintenance air shooter.....          | ....         | 6.00            |
| Cost of decreased production.....     | ....         | 4.73            |
| Cost of increased labor drilling..... | ....         | 13.70           |
| Cost of increased labor shooting..... | ....         | 13.70           |
| Total.....                            | \$68.72      | \$52.24         |

After the air shooter had been in operation six weeks it was decided that a screen test of the product made was in order. To make the test comparable two full cuts of each type of coal air and powder shot, were taken and run through the tipple over the screens and into the railroad cars in the regular manner and weighed. The weights were converted into percentage form and are shown below:

| Coal size          | Powder shot, percentage | Air shot, percentage | (+) or (-) change, air over powder |
|--------------------|-------------------------|----------------------|------------------------------------|
| 6" lump .....      | 10.09                   | 18.45                | +82.9%                             |
| 6" x 3" egg .....  | 20.12                   | 19.98                | -0.7%                              |
| 3" x 2" egg .....  | 13.28                   | 12.33                | -7.1%                              |
| 2" screening ..... | 56.51                   | 49.24                | -13.1%                             |

It is interesting to note that all the gain made due to air shooting was in the 6-in. coal, all the other sizes were decreased. This is as it should be because the 6-in. lump is the size commanding the premium price. The increased realization due to air shooting was obtained by taking the selling price of each size coal, multiplying by the percentage of each size thus obtaining the total realization for each type of shooting—air and powder. The difference between the two types is the net realization and in our case amounted to .0846 per ton in favor of the air-shot coal. Thus if the air shooter shot 400 tons of coal per day the extra realization would be \$33.84, if it shot 500 tons it would be \$42.30 and



Prepared for Shipment

for 600 tons it would be \$50.76, etc. The capacity of the air shooter at the Kings mine working under conditions found here is 660 tons of coal per seven-hour day.

During the trial period the capacity of the Sullivan Airdox unit was determined from detailed time studies. These studies were made for a period of two days involving the shooting of a total of 180 holes or 19 wide and 7 narrow places. During this period an average pressure of 10,000 lbs. per sq. in. was used, and a shell having 325 cu. in. capacity was used. From these studies the working unit standard times were made and the standard capacity of the airdox unit was set up from these unit standards. The method used to determine the standard production follows:

| Element                                      | Unit time | No. units | Minutes per cut |
|----------------------------------------------|-----------|-----------|-----------------|
| Tram with machine.....                       | 6.00      | 1         | 6.00            |
| Prepare to shoot.....                        | 1.57      | 8         | 12.56           |
| Shoot coal .....                             | 1.50      | 8         | 12.00           |
| Load tools .....                             | 1.47      | 1         | 1.47            |
| Total.....                                   |           |           | 32.03           |
| Allowances for unavoidable delays, 10% ..... |           |           | 3.20            |
| Total standard time per cut.....             |           |           | 35.23           |
| Cuts per 7 hours.....                        |           |           | 12              |
| Tons per 7 hours (7' coal).....              |           |           | 660             |

To prepare the 12 places for the air shooter requires the use of two sets of drillers. The reason for this is that instead of drilling a 2½-in. hole, a hole 4¼ in. in diameter must be drilled; and in addition to this 8 holes must be drilled per cut whereas only 4 holes were used with powder shooting. This is one of the main disadvantages of the air method of dislodging the coal face: the large diameter hole and the greater number of holes per cut.

Time studies were made on the drillers working in air-shooting section using the larger drill required to drill the 4¼-in. holes for a period of three days. Analysis of these studies show that two men can prepare seven places or 385 tons in seven hours. Now since the capacity of the air shooter is 660 tons it was found necessary to use two sets of drillers. Study of the unit standard times and the derivation of the drillers' capacity follows:

| Element                                     | Unit time | No. units | Man-minutes per cut |
|---------------------------------------------|-----------|-----------|---------------------|
| Tram with drill.....                        | 8.00      | 1         | 8.00                |
| Set-up drill .....                          | 9.60      | 3         | 28.80               |
| Drill holes .....                           | 4.78      | 8         | 38.24               |
| Change bits .....                           | .67       | 8         | 5.26                |
| Bugdust kerf .....                          | 20.00     | 1         | 20.00               |
| Load tools .....                            | 3.87      | 1         | 3.87                |
| Total.....                                  |           |           | 104.17              |
| Allowance for unavoidable delays, 10% ..... |           |           | 10.42               |
| Total standard time per cut.....            |           |           | 114.59              |
| Cuts per 7 hours.....                       |           |           | 7                   |
| Tons per 7 hours (7' coal).....             |           |           | 385                 |

To determine what effect the air-shot coal had on the productive capacity of the Joy loader and to compare it with the capacity when loading powder-shot coal, time studies were made for a period of four days each loading air-shot and powder-shot coal. Attention is called to the fact that in the comparison all items

except "loading coal" are same in both cases. This was done so that the result obtained is not distorted by the difference in "Joy moving" time and "changing car" time, or any other cause. The only difference affecting the result can come through the "loading coal" time of the individual loader, which time is of course directly dependent upon how well the coal is prepared for the loader in each case. The difference in the capacity of the loader when loading air-shot and powder-shot coal amounts to 11 tons per day or 3 percent in favor of the powder-shot coal. While this difference is not large it was, like all items affecting the air-shooting method, taken into consideration and listed under the proper heading. The method used to derive and compare the standard capacities of the Joy loader is shown herewith.

In conclusion the writer wishes to say that the air method of dislodging the coal face is not a cure-all for the ills incident to the preparation of coal for mechanical loaders. Preparation of the coal face before blasting must be done in accordance with the best practice determined by experience at each individual mine. Undercutting of the coal face

| Element                                    | Powder shot coal |           |                 | Air shot coal |                 |
|--------------------------------------------|------------------|-----------|-----------------|---------------|-----------------|
|                                            | No. units        | Unit time | Minutes per cut | Unit time     | Minutes per cut |
| Tram with machine.....                     | 1                | 5.00      | 5.00            | 5.00          | 5.00            |
| Load coal .....                            | 19               | 1.85      | 35.15           | 2.00          | 38.00           |
| Change cars .....                          | 19               | 1.10      | 20.90           | 1.10          | 20.90           |
| Get empties .....                          | 19               | .30       | 5.70            | .30           | 5.70            |
| Total.....                                 |                  |           | 66.75           |               | 69.60           |
| Allowance for unavoidable delays, 10%..... |                  |           | 6.67            |               | 6.96            |
| Total standard time per cut.....           |                  |           | 73.42           |               | 76.56           |
| Cuts per 7 hours.....                      |                  |           | 5.7             |               | 5.5             |
| Tons per 7 hours (7' coal).....            |                  |           | 378             |               | 367             |

must be done right. By right is meant a cut of predetermined dimensions with square face and ribs—when cut with short-wall machine. If a face is rounded in half moon shape, and "packets" are made in the ribs the effect of good shooting, either powder or air, will be largely minimized and prove ineffective in properly dislodging the coal face because the charge spends most of its force in the pockets while the face proper remains more or less hanging. This produces excessive fines at the ribs and coal too hard for proper loading at the face. Furthermore, if coal is improperly cut the chances are that it will be improperly drilled because the natural tendency

of the average driller is to drill the coal as it is cut. Hence if a cut angles and is gripped excessively into the rib the drill holes will also angle the same way, which as said before, tends to minimize the effect of the dislodging agent. Lastly the under cut must be properly and thoroughly bugdusted. Obviously it is useless to cut a 5½-in. kerf if 4 in. of it remains choked with dust and only 1½ in. of free space remains in which the expansion of the shattered coal is to take place. However, be it said here that by carrying out the preblasting operations properly and then using air as the dislodging agent satisfactory results can be obtained.

## Lake Superior Iron Deposits

(Continued from page 30)

lessening of porosity, but apparently without great change of grade.

Ores are found where surface oxidation and leaching have been active, both in proximity to igneous dikes and in their absence. The eastern Menominee has only one dike known in contact with iron formation along some 25 miles of the range. This dike has no effect on the ore. The western Menominee has only three known dikes in the iron formation of two counties. One of these promotes concentration by forming a structural trough in conjunction with a fold in the foot. The others are without influence on the ore. The Marquette and Gogebic carry much ore in dike trough structures. Faults and folds are equally important on the Marquette as compared with dikes. The hard ores of the Marquette are found indifferently under, above, or near or far from dikes, but are affected by proximity to Post-Laurentian granite. Three different faults on the Gogebic have had major effects on ore concentration independent of the dikes. The Mesabi is free from dikes almost completely. Both Mesabi and Gogebic reach their nadir of value in proximity to great Keweenawan lacoliths. The Cuyuna is nearly or entirely

free from post-iron-formation intrusives. Igneous rocks on the Vermillion in contact with the iron formation are nearly or entirely contemporaneous volcanics and affect the ores only as they afford impervious horizons for the control of surface waters. The specularization of ores and iron formation is attributable to subsequent folding and Post-Laurentian granite intrusion like that on the Marquette.

The detailed process of derivation of the original carbonate iron formations is still not fully understood. In widely scattered ages and different quarters of the globe rocks of this type are found associated with the dying off of a volcanic epoch. In the vicinity of iron formations the lavas, ancient or modern, often show a texture called ellipsoidal, which seems to be due to subaqueous

extrusion of the lavas. Nowhere in the Post-Cambrian have the amounts of this type of iron formation been comparable to those of the Pre-Cambrian. The reason for this enormously greater development in the Pre-Cambrian is not known. It may possibly be connected with the higher iron content of Pre-Cambrian lavas and the large proportion of this which is in the ferrous condition, as well as with the absence of terrestrial vegetation in Pre-Cambrian time.

The Upper Huronian iron carbonates carry less evidence of immediate volcanic precursor rocks than the older iron formations.

The Lake Superior iron districts have produced since the early 1840's about 1,600,000,000 tons of ore, and have a known reserve of something under twice the same amount. The further unknown tonnage is undoubtedly large, but it would be a bold prophet who would forecast the discovery of another Mesabi. The district has for a long time supplied 85 per cent of the nation's iron ore, and can continue to do so for at least a generation. Beyond that the large scale future lies with exploration, which will depend more and more for its success on scientific research and effort. Dimmed though the present may be in the slowly dispelling and persistent mists of man-made and man-prolonged gloom, still, as alluringly as ever they have in the past, bold adventure and high endeavor beckon us on to realization of that future.



# SAFETY SAVES SORROW

That  
Men Shall Live  
To  
Enjoy Life  
Is the Reason for  
SAFETY

**H**AVING been asked to write an article on safety for THE MINING CONGRESS JOURNAL, and then reading the finely prepared and scientific articles appearing therein, I knew I could never compete with them, but still, I did not want to refuse doing something that might help in this noble work of saving life and limb, so I decided to use an ordinary subject and try to tell about it in ordinary "coal-digger language." I find after all, so far as men and local mine management are concerned, they speak a universal language that is understood by all.

In this article we shall deal very little with records or statistics. We believe most companies are making progress and, in time, we will have a national coal mining safety record that will be the equal of any, and better than most.

There are some important phases and factors that must be given consideration in all our safety work, and it is the intention of this article to discuss what seems to me to be the most important.

## DISCIPLINE

The subject is one that is misunderstood many times, as some of us are inclined to think that it means penalty, and penalty only. Such is not the case, as it pertains to the ideals of the safety movement. Too much discipline of the wrong sort is a sign of weakness. It is an indication that the mine management is in a nervous state and does not know what to do to better a bad condition and, in retaliation, seeks to remove what it believes to be a cause, instead of educating the cause to better and safer work.

Discipline, as some one has said, is like the bridle in the hands of a good rider, and should extend its influence without appearing to do so; should be ever active, both as a support and restraint, yet seem to lie easily in hand. It must always be ready to check or to pull up, as occasion may require, and only when the horse is a runaway should the action of the curb be perceptible.

\* Safety Director, Hanna Coal Company of Ohio, St. Clairsville, Ohio.

By WILLIAM ROY, SR.\*

You can readily see that discipline requires a lot of patience—it should be a good teacher, as well as the master who penalizes for infractions or violations of existing standards or recognized rules. Discipline can be administered in the form of awards. Rules, plans, and all other agencies for the promotion of anything worth while are nothing more than a form of discipline, and if the reward of success is patiently taught to those who are required to carry out the plans, then we have discipline in its highest form. We all remember the old adage, "No cross—no crown," and this exemplifies what we mean by discipline in safety work. The so-called burden or inconvenience caused by a strict adherence to rules returns to us a hundredfold of peace and satisfaction.

Discipline is a help and support. It teaches us to do our work the correct way, and it also restrains us from doing it the wrong way, or it penalizes us in such a way as to cost more to do it the wrong rather than the right way. Why is it impossible to get safety without well-planned and carefully executed discipline?

*First*, because many men become so familiar with the dangers surrounding them, they become careless.

*Second*, because so many are fatalists and believe if an accident is going to happen, nothing can be done to prevent it.

*Third*, because so many think by obeying all laws pertaining to safety they are losing time, and thereby reducing their earning capacity.

*Fourth*, because they have never been injured, they believe they never will and, therefore, there is no need to keep telling them of rules and regulations.

Yet all the while they are thinking this way and believing in a false philosophy, thousands are being injured and hundreds killed. Therefore they must be restrained by some method—the severity

to be determined by the violation and the attitude of the employee himself.

A train must run upon a track prepared for that purpose. The track is discipline to the train. It keeps it within bounds; it carries its human load safely to its destination. It causes the train to arrive at each station on time. This same kind of discipline must be applied to the miner who loads coal under unposted stone. He must know, as the railroad section foreman knows, that the track must be kept in good order to avert wrecks, and posts must be set to prevent fatalities.

Discipline is not penalty, except to the man who refuses to abide by and carry out the rules for safety, and it should be a penalty to him, just as the man who neglects to keep the track in shape for the train should be severely punished.

Discipline is not penalty to the football player who is told what time to go to bed, what to eat, when to eat it, and just what plays to make and how to make them. It is glory to him, and every miner should be taught and should feel the same way about his job.

We must tie ourselves down in order to be free. We must all have a track upon which to live, for if man were left to promiscuously use his own judgment and have his own way, we would soon live in a world of chaos and destruction.

I believe we should stop talking so much about safety, for everyone who works in a coal mine now knows safety is a requirement, and begin to put into effect a well-planned, kindly administered discipline and, like a well-trained army, we will win our battle.

Know the rules, know how to work safely, plan for it in advance, strictly observe every requirement, and we will know the joy that comes to the conquering general when he wins a battle, or that which comes to the flashy football player who makes the needed touchdown.

The very orders that seemed to be penalties are the ones that bring you home safe and sound each day. Any mine well planned, carefully supervised, with kindly but strict discipline, will be a safe mine.



# May COAL CONVENTION and EXPOSITION

**M**ODERNIZATION of coal mining methods, practice and equipment will be the theme of the Thirteenth Annual Coal Convention and Exposition of The American Mining Congress, opening at Music Hall, Cincinnati, Ohio, May 11. The program which has been recently released to the coal industry is designed to give impetus to mechanization, and to present to the industry the most recent information concerning the application of modern production principles. Recent reports from the industry and from government statistical agencies indicate that mechanization grew substantially in 1935, and that 1936 will find a still greater increase.

Final program will be released by R. E. Salvati, general manager, Island Creek Coal Company, and chairman of the Program Committee, about April 1. Meantime the Committee on Arrangements is working diligently to develop a wide attendance, outstanding entertainment, and efficient handling of the meeting. This committee, which is under the direction of S. W. Blakslee, Philadelphia & Reading Coal & Iron Company, is composed of the following representatives of coal companies and manufacturers of mining equipment:

## COMMITTEE ON ARRANGEMENTS

—*Chairman:* S. W. BLAKSLEE, Prod. Mgr., Philadelphia & Reading Coal & Iron Co.

### 1. WELCOMING:

E. B. Agee, Supt. of Dehue Mines, Youngstown Mines Corp.

John T. Ryan, Mine Safety Appliances Co.

### 2. ATTENDANCE:

#### *Chairmen—*

W. P. Vance, Gen. Supt., Butler Cons. Coal Co.  
G. R. Delamater, Asst. V. Pres., The W. S. Tyler Co.

#### *Members—*

Frank Smith, Sunday Creek Coal Co.  
C. J. Sandoe, Perry Coal Co.  
B. H. Schull, Binkley Mng. Co.  
P. C. Graney, C. C. B. Div., Koppers Coal & Trans. Co.  
J. J. Sellers, Virginia Iron, Coal & Coke Co.  
E. R. Price, Inland Steel Co.  
L. Russell Kelce, Hume-Sinclair Coal Mng. Co.  
Geo. H. Rupp, Colorado Fuel & Iron Co.  
T. R. Johns, Industrial Collieries Co.

### 3. FLOOR:

#### *Chairman—*

W. W. Dartnell, Mgr. of Mines, The Valley Camp Coal Co.

#### *Members—*

M. R. Budd, Asst. Adv. Mgr., Hercules Powder Co.  
C. W. Connor, Supt. of Mines, Nellis Coal Corp.  
F. F. Jorgensen, Consolidation Coal Co.  
M. D. Cooper, Div. Gen. Supt., Hillman Coal & Coke Co.

### 4. ANNUAL DINNER:

C. E. Hough, Engr., Koppers Coal & Transportation Co.  
A. S. Knoizen, Joy Mfg. Co.

### 5. ENTERTAINMENT:

#### *Chairman—*

W. D. Turnbull, Westinghouse Elec. & Mfg. Co.

#### *Members—*

J. R. Ulrich, Bethlehem Steel Co.  
L. Russell Kelce, Hume-Sinclair Coal Mng. Co.  
H. C. Stelling, Union Carbide & Carbon Corp.  
H. H. Taylor, Jr., Franklin County Coal Corp.  
C. P. Daniel, Enterprise Wheel & Car Corp.  
H. B. Husband, Chesapeake & Ohio Fuel Mines.  
C. E. Hough, Koppers Coal & Transportation Co.  
A. R. Joyce, Wood Preserving Corp.  
A. S. Knoizen, Joy Manufacturing Co.  
R. J. Ireland, Jr., Owl Creek Coal Co.

### 6. PUBLICITY:

#### *Chairman—*

A. Brogini, Adv. Mgr., National Carbon Co.

#### *Members—*

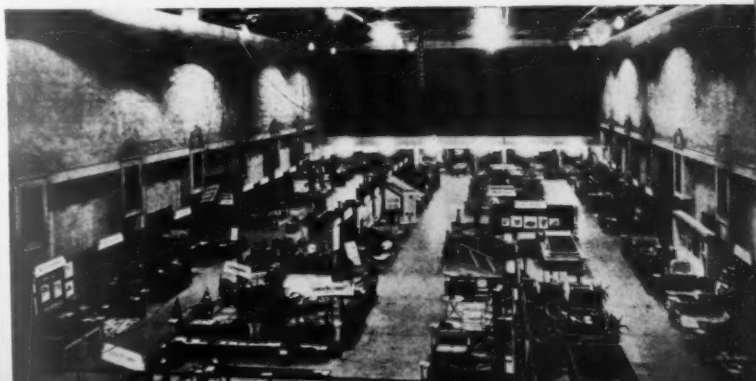
H. J. Saladin, Standard Oil Co., Inc.  
W. W. Rodgers, Westinghouse Elec. & Mfg. Co.  
W. H. Cordes, American Steel & Wire Co.  
Louis J. Ott, Ohio Brass Co.  
J. X. Farrar, Jeffrey Mfg. Co.  
Karl H. Runkle, General Electric Co.  
W. H. McWilliams, Editor, *Hanna Coal News*.

### 7. PRIZE CONTEST:

E. C. Reither, Timken Roller Bearing Co.

### 8. LADIES' ENTERTAINMENT.

The exposition, always an important factor in these meetings, will be the largest in history. All available space is now under contract, with the meeting still two months away. The displays will be unusual, with everything that goes into coal production exhibited. From grease to loading machines; from bearings to mine cars; from face preparatory equipment to "treated coal" for the market, the exposition will offer the maximum to the delegates. The Thirteenth Annual Convention is one not to miss.



# Mechanization Trends



**M**ECHANIZATION means power, and in the present trend toward machine methods in coal mining the question of proper and adequate lines is becoming increasingly important. This subject is being studied by our operators committees, and several of the districts have already gathered some interesting figures, a part of which are presented here. However, it should be emphasized that this is merely preliminary to the final

project report, which will be completed in the near future.

Tabulations of data on the practices that are being followed by representative

*Note: This is the first of a series of reports from the Operators' Committees of the American Mining Congress—"Preliminary Reports on Conductors for Direct Current Distribution Under Ground."*

companies have been submitted by the district committees of Illinois, Pittsburgh, northern West Virginia, New River West Virginia, and Ohio, and the conclusions drawn from a study of these practices will be presented in the project report. Extracts from these figures are given in the table below. The Ohio report was received too late for inclusion in this publication and their figures will be shown later.

In addition to this data the committee of northern West Virginia has made a study of resistance and line drops with various sizes of conductors and returns, and have prepared two graphs showing the relations between resistance and power losses to the distance that the current is transmitted.

## REPORT BY NORTHERN WEST VIRGINIA DISTRICT

Too much stress cannot be placed upon the selection of proper feeder and trolley sizes in the average mine. The committee is not attempting to deal at this time with the subject of advancing substations to bring the source of power closer to the working sections, but is

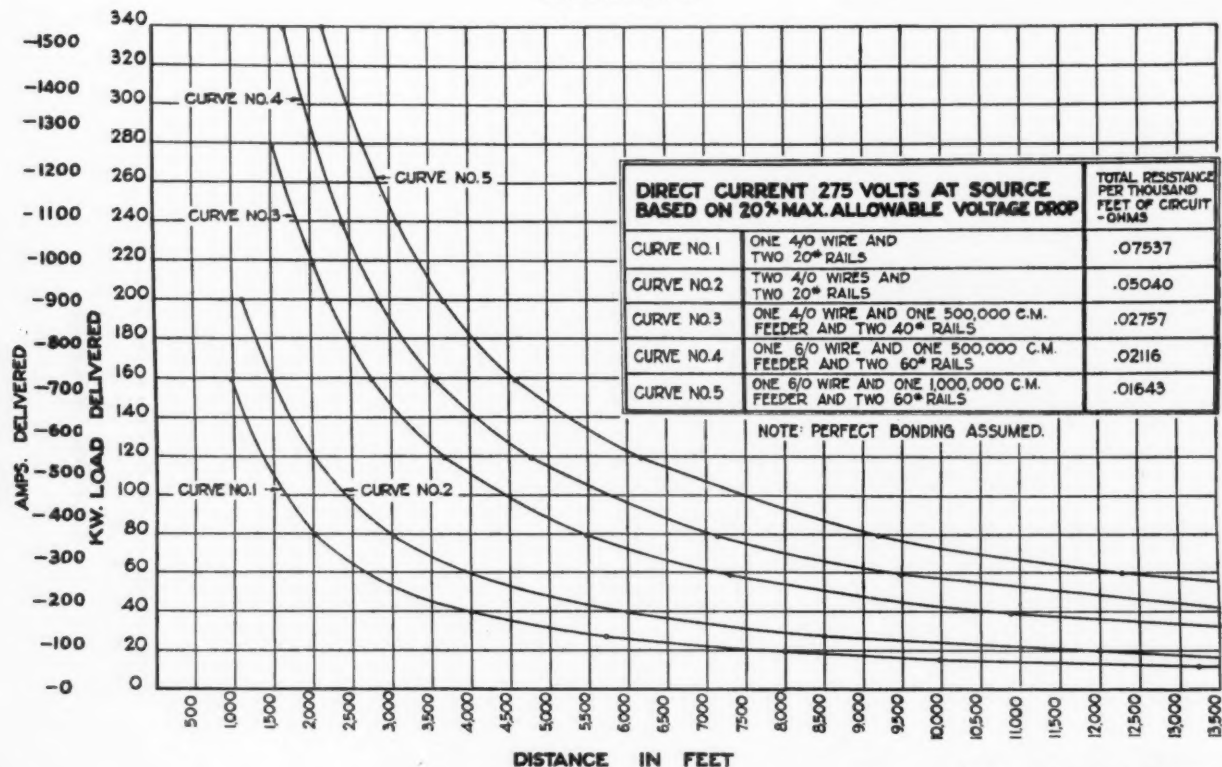
attempting to show a simple method whereby the mine electrician or superintendent may realize the necessity of having plenty of conductor for his D.C. current. The committee felt the need for a quick method of determining the wire and rail sizes necessary for adequate direct current distribution in the coal mines and have prepared, along these lines, two graphs which will be found useful in a rapid solution of such problems.

Graph No. I shows the resistance per thousand feet for weights of rail between 16 and 100 lbs. Two simple formulas are also given on this graph which will solve any direct current distribution problem.

The committee suggests that if an approximate method of calculating copper wire size is needed the following may be helpful. Few trolley lines are 100 percent perfect in section or in efficiency, and this short method should be of assistance to the average mining man.

To figure the resistance of any copper conductor, divide the circular mills of conductor into 10,000 and add 10 percent.

GRAPH NO. II



Submitted by M. W. Horgan

# COAL OPERATORS' COMMITTEES OF THE AMERICAN MINING CONGRESS

Extract from Reports of District Committees on  
CONDUCTORS FOR DIRECT CURRENT DISTRIBUTION UNDERGROUND  
Showing Representative Practices for Trolley Lines, Feeders and Returns

| Mine Location           | Length<br>D.C.<br>Circuit | Main Line Haulage |                        |                   |                |                 | Cross<br>Bonds* | Gathering Haulage      |                |            | Bonds |
|-------------------------|---------------------------|-------------------|------------------------|-------------------|----------------|-----------------|-----------------|------------------------|----------------|------------|-------|
|                         |                           | Trolley<br>Wire   | Feeder<br>(cir. mills) | Feeder<br>Tie-ins | Rail<br>Weight | Trolley<br>Wire |                 | Feeder<br>(cir. mills) | Rail<br>Weight |            |       |
| ILLINOIS—South Central  |                           |                   |                        |                   |                |                 |                 |                        |                |            |       |
| Mine No. 1.....         | 3,000'                    | 6-0               | 3 @ 4-0                | 2,000'            | 60lb           | ...             | 4-0             | 4-0                    | 30lb           | 4-0        |       |
| " " 2.....              | 4,000'                    | 4-0               | 3 @ 4-0                | 4,000'            | 65lb           | ...             | 4-0             | 4-0                    | 30lb           | 2-0        |       |
| " " 3.....              | 2,000'                    | 6-0               | 750,000                | 1,000'            | 60lb           | ...             | Sto. Bat.       | Sto. Bat.              | ....           | ...        |       |
| " " 4.....              | 2,000'                    | 4-0               | 1 @ 4-0                | 800'              | 30lb           | ...             | Sto. Bat.       | Sto. Bat.              | ....           | ...        |       |
| " " 5.....              | 3,000'                    | 4-0               | 1,000,000              | 500'              | 56lb           | ...             | 4-0             | ...                    | 30lb           | 2-0        |       |
| WEST VIRGINIA—Northern  |                           |                   |                        |                   |                |                 |                 |                        |                |            |       |
| Mine No. 6.....         | 6,000'                    | 6-0               | 6-0                    | 25'               | 60lb           | 100'            | 4-0             | 4-0                    | 40lb           | Wire-ret.  |       |
| " " 7.....              | 18,000'                   | 6-0               | 4,000,000              | 200'              | 60lb           | 150'            | 4-0             | 4-0                    | 40lb           | Wire-ret.  |       |
| " " 8.....              | 5,000'                    | 4-0               | 1,500,000              | 1,000'            | 30lb           | 300'            | 2-0             | 250,000                | 20lb           | Both rails |       |
| " " 9.....              | 10,000'                   | 6-0               | 1,000,000              | 200'              | 60lb           | 200'            | 4-0             | 750,000                | 30lb           | Wire-ret.  |       |
| " " 10.....             | 8,000'                    | 4-0               | 750,000                | 250'              | 40lb           | 300'            | 4-0             | 500,000                | ....           | Wire-ret.  |       |
| WEST VIRGINIA—New River |                           |                   |                        |                   |                |                 |                 |                        |                |            |       |
| Mine No. 11.....        | 6,000'                    | Sec. 9            | 1,000,000              | 333'              | 75lb           | 300'            | 4-0             | None                   | 20lb           | Yes        |       |
| " " 12.....             | 9,500'                    | 6-0               | 500,000                | 28'               | 60lb           | 200'            | 4-0             | None                   | 30lb           | Both rails |       |
| " " 13.....             | 4,000'                    | 6-0               | 500,000                | 200'              | 60lb           | 200'            | 4-0             | 4-0                    | 30lb           | Both rails |       |
| " " 14.....             | 8,000'                    | 4-0               | 4-0                    | ...               | 45lb           | 200'            | 4-0             | None                   | 30lb           | Both rails |       |
| " " 15.....             | 10,000'                   | 4-0               | 900,000                | ...               | 40lb           | None            | 4-0             | None                   | 30lb           | Yes        |       |
| PENNSYLVANIA—Pittsburgh |                           |                   |                        |                   |                |                 |                 |                        |                |            |       |
| Mine No. 16.....        | 12,000'                   | 4-0               | 2,000,000              | 20'               | 60lb           | 200'            | 4-0             | None                   | 40lb           | One rail   |       |
| " " 17.....             | 10,000'                   | 4-0               | 1,500,000              | 164'              | 60lb           | Yes             | 4-0             | 250,000                | ....           | Both rails |       |
| " " 18.....             | 9,000'                    | 6-0               | 4-0                    | 500'              | 60lb           | Yes             | 4-0             | None                   | 40lb           | One rail   |       |

Data submitted by:

CARL LEE, Chairman, South Central Illinois.  
M. W. HORGAN, Chairman, Northern West Virginia.  
S. AUSTIN CAPERTON, Chairman, New River, W. Va.  
C. W. GIBBS, Chairman, Pittsburgh, Pa.

\* All of these mines have both rails bonded or use welded rail joints.

Tables showing equivalent copper value in circular mills for steel rails are not always available. Divide the weight of the rail in pounds per yard by 10 to obtain the area of section in square inches. Example:

$$\frac{40}{10} = 4 \text{ sq. in. in section.}$$

Each square inch of rail section has an equivalent copper value of 100,000 c.m., then for 40-lb. rail this would be:  
 $4 \times 100,000 = 400,000 \text{ c.m. (Approximate)}$

Graph No. 2 shows the distance in feet that any kilowatts or amperes of load can be delivered for a set of five given conditions of rail and copper weights. These graphs solve immediately any problem in these combinations. Other combinations may be plotted in between the five curves if found necessary to suit conditions different from those given.

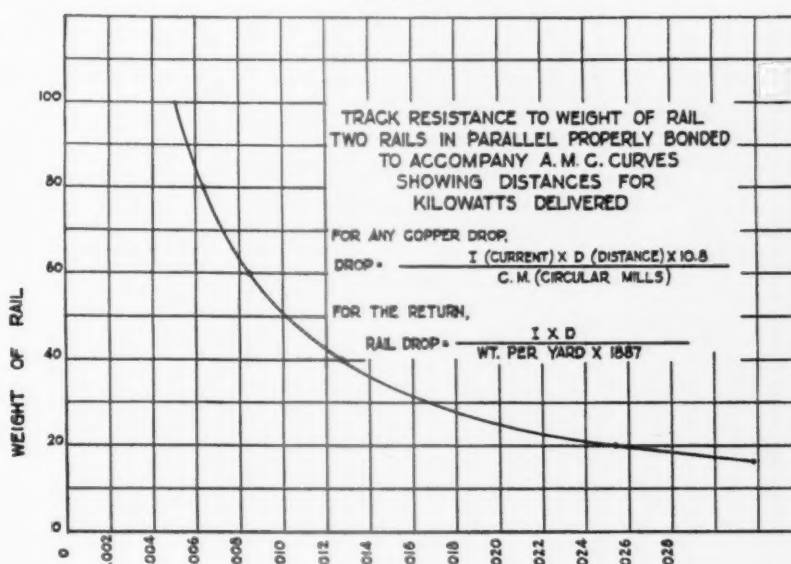
Considerable thought has been given to the use of No. 9/0 wire in straight haulways but, due to the difficulties encountered because of its large size and weight

in stringing, it is felt that the present largest trolley wire size, which is No. 6/0, 9-section, of about 415,000 c.m., is the largest size the committee can recommend for installation at this time. However, the matter of 9/0 wire is being considered by several manufacturers through the committee's efforts.

Submitted by,

M. W. HORGAN, Chairman.  
B. G. SAMPSON.  
E. D. FORTNEY.

GRAPH NO. I



RESISTANCE PER 1000 FT. RAILS BONDED & CROSS BONDED

Submitted by M. W. Horgan and F. L. Stone

MARCH, 1936



# News and Views

## of Interest to Mining Men

● **THE TREASURY'S** stock of silver has reached 21.8 percent of the monetary gold stock, compared with 12 percent when the silver program started. Under the Silver Purchase Act, the silver reserves must amount to 33 percent of the gold stocks. This means that approximately 908,000,000 ounces of silver must still be purchased. Total Treasury holdings of silver now are in excess of 1,642,000,000 ounces having a monetary value of \$2,118,600,000, compared with silver holdings valued at \$928,900,000 when the silver program started.

The Treasury statement for February 11 reflected the purchase of \$7,300,000 of silver, presumably from China. The Treasury's silver bullion stocks were shown to have increased by that amount over the previous day, and its gold in the general fund decreased by a like amount. The total Chinese transaction, however, is in excess of \$9,000,000. The rest of the transaction, it is assumed, will be shown on subsequent dates.

Secretary Morgenthau revealed for the first time that the total Treasury purchase of silver from China, negotiated in November, amounted to 50,000,000 ounces. The Treasury paid China the then prevailing price of 65 cents an ounce, making the total cost to the United States \$32,500,000. China has kept this balance in New York, the Secretary explained, and recently requested that \$10,000,000 of it be converted from dollar balances into actual gold. This request led to the earmarking of gold disclosed on the New York Reserve's bank statement.

Secretary Morgenthau said that China could have the rest of its balance in gold at any time it wanted. He expressed great admiration for the success of the new Chinese managed currency.

The purchase of 50,000,000 ounces is the last transaction between the United States and China. It was preceded more than a year before by the direct purchase of 19,000,000 ounces.

Mexican silver is bought by the United States at the New York price each day, Secretary Morgenthau said. His statement definitely denied rumors that the secret silver agreement with Mexico calls for a bounty on Mexican silver.—As reported by the Wall Street Journal.

● **THE ANNUAL MEETING** of the American Zinc Institute, Inc., will be held at Hotel Statler, St. Louis, Mo., Monday and Tuesday, April 20-21, 1936.

● **ANALYSIS** of current employment statistics revealed that employment is higher in intensely mechanized industries in comparison to predepression levels than it is in occupations in which few or no machines are used. The facts were cited by the Machinery and Allied Products Institute in connection with its study of technological advancement which showed that machines increase rather than decrease employment opportunities.

"In none of the industries with low employment figures can it be charged that machines have displaced men, but rather that various factors have brought a temporary lack of demand for the goods they produce," the report said.

### EXCELSIOR?



—The Washington Post

● **THE AMERICAN IRON & STEEL INSTITUTE** recently announced that the steel industry's investment in continuous sheet and strip mills will be approximately \$200,000,000 when mills now authorized or in process of construction are completed. The announcement says "This investment which has been spread over a 10-year period, represents the over-all costs of constructing 21 continuous four-high mills with an aggregate capacity for producing almost 9,000,000 gross tons of hot rolled sheets and strip steel per year."

● **THE** following copy of the Preamble of the Constitution of the Independent Anthracite Miners Association with headquarters at Brandonville, Pa., is of interest:

### PREAMBLE

Realizing the reason why we must resort to the present form of digging coal, is due to the fact that, we as workers and coal miners are hit by this terrific unemployment and depression, and that the amount of relief given us by the state agencies is not enough to keep our families in sufficient food, clothing and shelter.

We must dig the coal out of these mountains as a means of supplementing our measly income that we receive, in the form of relief, in order to keep the wolf away from our doorsteps.

Knowing that the coal, which is in these mountains, was put there by our Creator, and that this mineral wealth was stolen away from us by the greedy rich class, the coal operators and the bankers.

We, as the workers and members of this Association do hereby agree, that we will uphold our interests as workers and will use our organized strength, jointly and collectively, to fight and maintain the right for us to dig this coal and make the lot of our members more bearable.

We are undertaking an obligation, that we will protect the rights of our members, through mass action and mass pressure against the coal companies and all their agencies, and that we will continually fight, side by side, with the rest of the unemployed workers, for an increase in relief, rent and shelter to be paid to the unemployed workers, by the state in the form of cash relief.

Also, knowing that we will not be able to continue these operations indefinitely, and that this source of income is insecure and only for a period of time, we will fight for security against starvation, by fighting for the Workers Unemployment and Social Insurance Bill.

### CONSTITUTION

1.—This Organization be governed by the following principles:

- a—A full control by the rank and file.
- b—Majority rule, minority submit and carry out wishes of majority.
- c—Officers and committees, who do not carry out the wishes of the majority, or who do not attend three consecutive meetings, shall be recalled at any time, that two-thirds of the membership present, desire to do so and new officers or committees be elected in their place.
- d—Officers to be elected semi-annually by rank and file consisting of president, vice president, secretary, financial secretary, treasurer and committees. Executive committee consisting of

four, and one committee man to be elected from each section consisting of five holes or more.

2.—a—Any person or persons not a member of the Independent Anthracite Miners Association, shall not be allowed to sell to any trucker not belonging to said association. And said truckers shall be instructed to ignore any person or persons not members of this association.

b—This organization shall hold its meetings twice a month and that at these meetings, provisions be made to hear the grievances and complaints of the members and transact them.

3.—a—That all coal holes started after January 15, 1935, be not less than 60 feet apart.

4.—a—The Executive Board shall make provisions to keep roads in repair by assessing each coal hole with one worker to repair the roads not more than one day a month.

5.—Any coal hole that is destroyed by an official of any coal company will not be protected by the Independent Miners Association unless they are members of said union.

6.—Members shall not go under any Highway.

Articles subject to change.—*Anthracite Institute.*

● **WORLD COPPER** stocks increased 4,600 tons during January. Total world refined stocks as of January 31, 1936, were 489,900 tons. Domestic stocks totaled 232,900 tons. Two large producers increased their prices early in February to 9.50 cents.

● **REPORTS** from the Tri-State Lead and Zinc District continue to be encouraging. F. R. Wadleigh, mining editor of the *Joplin Globe*, reports the supply of zinc concentrates far below the demand. The American Zinc Institute's reports show a sizable decline in metal stocks in the United States.

● **WAGE CONFERENCES** for the anthracite industry opened in New York on February 24. No prognostications were made as to how long the conferences would last. Unions are asking for a 30-hour week, higher wages, a complete check-off system and equalization of mine operations by each company. Operators are confronted with severe competition with oil and gas, and the "stolen-coal" situation.

● **PICKANDS MATHER & CO.** has awarded contracts for the construction and equipment of a modern screening plant at the Zenith iron mines at Ely, Minn. It is to have a daily capacity of 1,200 gross tons. Work will begin early in March, and the estimated cost is \$35,000.

## QUANTITY PRICE DIFFERENTIALS

Statement by The American Mining Congress on Utterback-Patman-Robinson bills, to amend Section 2 of Clayton Act

The American Mining Congress respectfully urges that crude mineral products and metals be excepted from any legislation amending Section 2 of the Clayton Act, relating to quantity price differentials.

The purpose of such proposed legislation is to remedy alleged abuses in retail merchandising, particularly in "Chain Store" operations. The inclusion in such legislation of those basic raw materials which are the products of mines would not help this objective, and would abrogate long-established and justified practices important to the welfare of the mining industry, of those employed in it, and of the public.

To avoid such consequences we suggest addition of the following paragraph as an amendment to the pending bills:

"Nothing in this section 2 contained shall prevent the sale or purchase of crude mineral products or metals in the form in which they are loaded for shipment at prices or terms of sale based upon differences in the grade, quality, or quantity of such products, or that make only due allowance for differences in the cost of selling or transportation, or discrimination in the price of such products in the same or different communities made in good faith to meet competition."

The portion of this amendment beginning with the words "differences in the grade . . ." follows the language of the present section 2 of the Clayton Act; hence mineral products would continue subject to the same degree of regulation as heretofore.

Crude mineral products and metals as loaded for shipment are bulk raw materials, and do not enter into the retail field; the alleged abuses in that field do not apply to the mineral industry.

Quantity sales and quantity price differentials under existing law are important factors in the efficient conduct of mining operations. They contribute to lower costs, more continuous operations, greater stability of employment, better extraction of mineral deposits and the utilization of large tonnages of lower grade or "marginal" ores which would otherwise be entirely lost. They are thus a potent influence in conservation of natural resources.

A classification or exception such as here proposed is entirely within the power of Congress to enact, provided such classification is not arbitrary or capricious but is based on a definite, recognized difference and is reasonably related to the purpose for which the regulation is designed. A long line of court decisions upholds this principle. This very week the Supreme Court has warned against "the difficulties and complexities which confront the legislator who essays to interfere in sweeping terms with the natural laws of trade or industry. The danger in such efforts always is that unintended dislocations will bring hardship to groups whose situation the broad rules fail to fit."

Both the factual and legal basis for the proposed exception are fully discussed in our statement before the House Judiciary Committee.

● **SUNSHINE MINING COMPANY'S** great achievement is not so much in raising its dividend rate from 2 cents a share to \$2 a share in five years, but in the heavy and costly improvements it made in 1935 while it was paying and raising its dividends. These operating betterments and mine improvements, with a slight increase in employees, enabled the company last year to increase tonnage extracted 43 percent and its silver recovery 70 percent in ounces, according to Frank Eichelberger, vice president in charge of operations. During the year he had 20 percent of the force on rehabilitation work.

The condition of the mine on the first of the year "compelled a tremendous

amount of repair and reconstruction," he states. "This work consumed 20 cents of every dollar spent underground."

Fourteen hundred feet of the 2,000-ft. shaft and all ore pockets were retimbered; the hoisting capacity of the shaft was increased 80 percent. Stope methods were changed from rill stopes to the cut-and-fill type, reducing 50 percent the dilution of ore with barren wall rock and increasing head assays from 32 to 40 ozs. per ton, and increasing markedly the production per man. Accidents in stopes were reduced; the ventilating system greatly enlarged, raising the efficiency of the men probably 10 percent. Additional fire precautions were taken and 24 men drilled in helmet work.

An entirely new mill unit was built during the year, and extraction averaged 97.4 percent. The continuity of the ore has been proven to the 3,100-ft. level, and Mr. Eichelberger states that the proved ore reserves are considered ample for any contemplated production, and it is necessary at this time to consider deeper exploration.

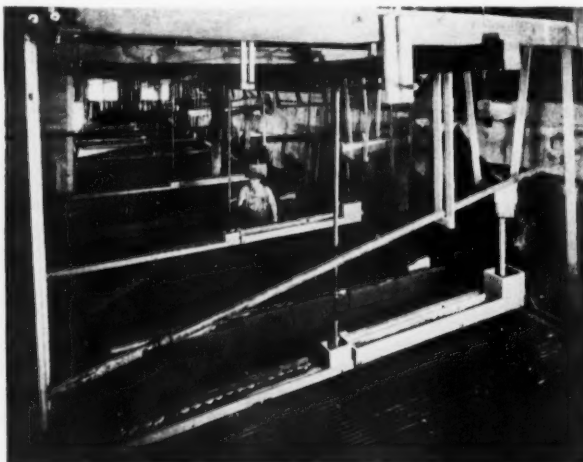
The big development for 1936 will be a new four-compartment shaft to be sunk 2,300 ft. as its first objective. It has a steel gallows frame and is equipped with a double drum, electrically driven hoist capable of lifting a four-ton payload from the 5,000-ft. level at a rope speed of 1,600 ft. per minute.

● THE opening of the so-called "dry-ore" belt in the Coeur d'Alenes has been like the discovery and development of a great new mining camp in the heart of one of the most important mining districts in America. Engineers, who a few years ago rejected the ore bodies of this region as they examined their surface workings, are coming back and now agree that in this area have already been developed, in the Sunshine mine, some of the richest silver ores to be found anywhere in the United States. They also quite generally agree that there is a reasonable likelihood of other profitable mines being developed.

This "dry-ore" belt, south of the Coeur d'Alene River and stretching for 7 miles between Wallace and Kellogg, is teeming with activity with hundreds of men employed, in addition to those at the Sunshine. All this ground has at least a prospective value, and there are several companies which have larger areas than the Sunshine Mining Company. The most important development is that of the Polaris, where a 1,000-ft. shaft has been sunk and a 2-mile tunnel is being completed by funds furnished by the Hecla and Newmont Companies. This work has opened high-grade silver ore. A new mill will be built in the spring.

● SUNSHINE CONSOLIDATED CO. has 75 claims adjoining the Sunshine and is opening its property by a cross-cut from the 1,700-ft. level of the workings of the Sunshine Company. Some of the Sunshine stockholders are said to be heavily interested in the Consolidated. Adjoining the Sunshine on the south is Metropolitan Mines Corporation, which is sinking a winze from a long tunnel. It received encouragement at the 200-ft. level and is now going on to the 400 level. Merger Mines Corporation is driving a tunnel to reach ore revealed by its diamond drills.

● SILVER DOLLAR MINING CO. has driven a tunnel which is now more than 7,000 ft. long, which the management expects will hit the Sunshine vein almost any day. This tunnel crosses the Polaris tunnel 100 ft. beneath it. This is a W. J. Stratton enterprise. Coeur d'Alene Mines Corporation has the old Mineral Point property between the Sunshine and Wallace. It has explored it by tunnel and diamond drills and is now making a 650-ft. raise from the No. 5 level to the 3½ level. The Idaho-Montana Mining Company property adjoins the Mineral Point on the south. This company has changed its name to American Silver Mining Company. The Chester property is being opened by a cross-cut from the Polaris tunnel. Mineral Mountain Mining Company is developing its property north of the Chester. The Elgin and Ogden, the Plainview and others are being worked and it is to be hoped that they too will find some of the ore which the Sunshine



*Interior, Mill, Carson Hills Gold Mining Co.*

Company has proved to be so extremely profitable.

● ACCORDING to figures submitted at the convention of the United Mine Workers of America, increased expenditures for labor in the coal mining industry from the summer of 1933 to March 31, 1937, as a result of the activities of the union, will approximate \$300,000,000. They report that increase in the Appalachian fields amount to 16 cents a ton, and the general bituminous field 15 cents a ton.

● A NEW procedure for settling income tax disputes which will relieve the taxpayer of expensive trips to Washington is being instituted by the Treasury, as announced in February.

Commissions will be dispatched to various cities to consider and compromise disputes in that locality. The first

commission has been sent to Cleveland. Its success will determine to a large degree the future extension of the new plan. Tentative arrangements are under way for sending other groups to Kansas City and Dallas. Later a commission may be sent to New York. Commissions dispatched will have full authority to settle cases before them.

● AMERICAN METAL CO., LTD., has granted an option to Consolidated Coppermines Corporation, involving the tender by the latter of 150,000 shares of common stock in exchange for 17,500 shares of American Metal Co. common stock.

● THE Sixteenth International Geological Congress that met in Washington, D. C., in 1933, undertook as part of its work the preparation of a summary of the copper resources of the world. The primary objective was to outline the geologic environment of the known copper deposits of the world. However, it was thought that a clearer picture of these resources in their economic and cultural bearing could be presented by including brief sections on the history of the development of the industry throughout the world, the financial and economic factors involved in the industry, and an estimate of the quantity of reserves with their geographic distribution.

Much of the geological material was contributed by official Government agencies. Wherever possible, contributions were obtained from geologists personally familiar with the several districts, although naturally this was not possible for all the deposits, and a few districts have been described from secondary sources. Only a very few copper-producing districts have been omitted from the discussion, which may fairly be said to be the most comprehensive treatment of the subject that has yet appeared anywhere.

The world's resources of copper are outlined here in considerable detail. Accurate expression of the total available reserves has been, of course, not feasible, owing to the impossibility of precise analysis of such complex factors as changing price levels, tariffs and other governmental policies, and metallurgical and mining practices.

Technologic aspects of the copper industry have not been systematically covered, although they are of controlling importance in the economic utilization of many of the deposits. Nevertheless it was decided to include a brief description of some of the mining methods employed in North America, as giving a picture of the current practice of a large

and representative part of the world's copper industry.

The compilation has now been published and is ready for distribution. It appears in two volumes.

● **SILVER** produced in the United States and the Philippine Islands increased from 32,982,433 ounces in 1934 to 48,047,899 ounces in 1935, an increase of 46 percent. The value of the 1934 production at \$0.646+ per ounce was \$21,321,976 and the value of the 1935 production at the weighted average of \$0.738 was \$35,459,349, an increase of \$14,137,373, or 66 percent. Production of silver in the United States and the Philippines in 1933 was 23,317,159 ounces, valued at \$0.35 per ounce, at \$8,161,006. The increase in 1935 over 1933 was 106 percent in quantity and 334 percent in value.

Producers of newly mined silver in the United States in 1935 began the year under the stimulus of the Government price of \$0.646464+ (one-half of the coinage value of \$1.29292929+). Acting under the President's proclamation of December 21, 1933, and the Silver Purchase Act of 1934, the Secretary of the Treasury on April 10 raised the price paid to \$0.7111 (55 percent of \$1.292929+) and on April 24 to \$0.7757 (60 percent of \$1.292929+).

The following table covering silver mining in 1935, supplemented by brief state reviews, is summarized by Charles W. Henderson from current reports of the western field offices of the U. S. Bureau of Mines.

● **THE UNITED STATES COAL COMPANY** in 1935 mined 3,500,000 tons of coal without a fatality.

● **THE NATIONAL BITUMINOUS COAL COMPANY** has advised the coal producers that it will use its authority to fix maximum prices for coal if this shall become necessary in the interest of the consumer. Chairman Hosford stated "It is the duty of the Commission to establish prices; the Commission has the power to fix maximum as well as minimum prices, and this power will be used if it is necessary to protect the consumer." It is not anticipated that "official" prices will become effective before April 1.

● IT is not now anticipated that the United States Supreme Court will hand down its decision in regard to the Guffey Coal Control Law before the first of April. Argument in the Carter case is scheduled to be presented March 13.

● A **BILL** which would authorize suspension of assessment work on mining claims for the year 1936, similar to the bill introduced and enacted last session, has been introduced in the House of Representatives, but in conferences between congressional representatives of the western states it has been agreed not to press for enactment. It is expected that the regular assessment work will therefore be required this year.

# MINE PRODUCTION OF SILVER IN THE UNITED STATES, BY STATES AND REGIONS. 1934-35, IN TERMS OF RECOVERED METAL

| State or Territory               | 1934<br>Fine<br>ounces | 1935<br>Fine<br>ounces | Increase (+) or<br>decrease (-) |              | Value                           |                                 |              |
|----------------------------------|------------------------|------------------------|---------------------------------|--------------|---------------------------------|---------------------------------|--------------|
|                                  |                        |                        | Fine<br>ounces                  | Per-<br>cent | 1934<br>At \$0.646<br>per ounce | 1935<br>per ounce<br>At \$0.738 |              |
| <i>Western States and Alaska</i> |                        |                        |                                 |              |                                 |                                 |              |
| Alaska                           | *168,868               | *203,465               | +                               | 34.597       | + 20                            | \$109,167                       | \$150,167    |
| Arizona                          | 4,448,474              | 6,375,000              | +                               | 1,926,526    | + 43                            | 2,875,781                       | 4,704,760    |
| California                       | 844,413                | 1,117,700              | +                               | 273,287      | + 32                            | 545,863                         | 824,863      |
| Colorado                         | 3,475,661              | 4,605,845              | +                               | 1,130,184    | + 33                            | 2,246,892                       | 3,399,114    |
| Idaho                            | 7,394,143              | 10,150,000             | +                               | 2,755,857    | + 37                            | 4,780,052                       | 7,490,700    |
| Montana                          | 4,006,468              | 9,370,000              | +                               | 5,363,532    | + 134                           | 2,590,040                       | 6,915,060    |
| Nevada                           | 3,057,114              | 4,280,000              | +                               | 1,222,886    | + 40                            | 1,976,316                       | 3,158,540    |
| New Mexico                       | 1,061,775              | 1,052,900              | -                               | 8,875        | - 1                             | 686,400                         | 777,040      |
| Oregon                           | 46,560                 | 112,000                | +                               | 65,440       | + 141                           | 30,099                          | 82,656       |
| South Dakota                     | 99,741                 | 142,513                | +                               | 42,772       | + 43                            | 64,479                          | 105,175      |
| Texas                            | 854,442                | 976,900                | +                               | 122,458      | + 14                            | 552,367                         | 720,952      |
| Utah                             | 7,111,417              | 9,133,900              | +                               | 2,022,483    | + 28                            | 4,597,280                       | 6,740,818    |
| Washington                       | 44,120                 | 50,900                 | +                               | 6,780        | + 15                            | 28,522                          | 37,564       |
| Wyoming                          | 710                    | 793                    | +                               | 83           | + 12                            | 459                             | 585          |
| Total                            | 32,613,906             | 47,571,916             | +                               | 14,958,010   | + 46                            | \$21,083,737                    | \$35,108,074 |
| <i>Eastern States</i>            |                        |                        |                                 |              |                                 |                                 |              |
| Alabama                          | 361                    | 395                    | +                               | 34           | + 9                             | \$233                           | \$291        |
| Georgia                          | 48                     | 75                     | +                               | 27           | + 56                            | 31                              | 55           |
| New York                         | 21,750                 | 21,750                 | -                               | 0            | 0                               | 0                               | 16,061       |
| North Carolina                   | 9,710                  | 7,021                  | -                               | 2,689        | - 28                            | 6,277                           | 5,181        |
| Pennsylvania                     | 6,230                  | 4,600                  | -                               | 1,630        | - 26                            | 4,027                           | 3,395        |
| South Carolina                   | 487                    | 177                    | -                               | 310          | - 61                            | 315                             | 131          |
| Tennessee                        | 61,148                 | 34,119                 | -                               | 27,029       | - 44                            | 39,530                          | 25,180       |
| Virginia                         | 103                    | 63                     | -                               | 40           | - 39                            | 67                              | 46           |
| Total                            | 78,087                 | 68,200                 | -                               | 9,887        | - 13                            | \$50,480                        | \$50,330     |
| <i>Central States</i>            |                        |                        |                                 |              |                                 |                                 |              |
| Illinois                         | 310                    | 3,147                  | +                               | 2,837        | + 915                           | \$200                           | \$2,323      |
| Michigan                         | 529                    | 529                    | -                               | 0            | 0                               | 342                             | 342          |
| Missouri                         | 63,066                 | 101,024                | +                               | 37,958       | + 60                            | 40,770                          | 74,556       |
| Total                            | 63,905                 | 104,171                | +                               | 40,266       | + 63                            | \$41,312                        | \$76,879     |
| <i>Philippine Islands</i>        |                        |                        |                                 |              |                                 |                                 |              |
| Philippine Islands               | *226,524               | *303,604               | +                               | 77,080       | + 34                            | \$146,440                       | \$224,066    |
| Puerto Rico                      | 11                     | 8                      | -                               | 3            | - 27                            | 7                               | 6            |
| Total                            | 226,535                | 303,612                | +                               | 77,077       | + 34                            | \$146,447                       | \$224,066    |
| Grand total                      | 32,982,433             | 48,047,899             | +                               | 15,065,466   | + 46                            | \$21,321,976                    | \$35,459,349 |

\* Refinery receipts.

● IN the supplement to the *Monthly Bulletin* of the American Tariff League issued recently, there appears an analysis of the foreign trade figures of the United States for 1935. In commenting on the relation of the reciprocal trade agreement program to the increase in foreign trade, the article reads, in part, as follows:

"The facts are that the major proportion of the increases in foreign trade in 1935 can in no way be associated with or accredited to be the result of trade agreement negotiations.

"No matter from what angle one approaches the record of foreign trade for last year, the evidence is the same. Increases in our foreign trade in 1935 as compared with 1934 were as follows:

Increase in total exports..... \$142,000,000  
Increase in total imports..... 392,000,000

"Three reciprocal trade agreements became effective during 1935. The total increase in trade that took place following the effective date of these agreements was as follows:

Increase in exports..... \$12,500,000  
Increase in imports..... 16,200,000

"(The three countries, with the effective dates of the agreements were: Belgium, May 1; Haiti, June 3; Sweden, August 5. It is impossible to make comparable comparisons with Cuba because the agreement with that country became effective in September, 1934.)

"Obviously, the increase in trade with these countries does not begin to account

for the considerable increase in total exports and imports of the United States in 1935. Even if the increase in trade with these countries were to be credited entirely to the results of the reciprocal trade agreements—which cannot truthfully be done—we have to look elsewhere to account for the bulk of the increase in our export and import trade last year. The increases are to be found distributed among a large group of countries, with none of which did we have a reciprocal trade agreement in 1935. The increase in exports to Canada amounted to \$21,000,000; to Argentina, \$6,000,000; to the United Kingdom, \$50,000,000; to Mexico, \$10,000,000. The increase in importations from this same group of countries was as follows: Canada, \$54,000,000; Argentina, \$26,000,000; United Kingdom, \$40,000,000; Mexico, \$6,000,000. These are but samples drawn from the complete list, and are cited to demonstrate the fact that the significant changes which took place were utterly unconnected with any activity in connection with the reciprocal trade agreement program. In many cases the increase in trade was not two-sided, as, for example, in the case of Japan. Our exports to Japan decreased by \$7,000,000, but our imports from Japan increased by over \$33,000,000.

"... This analysis does not mean that increased importations of certain commodities have not been stimulated by reductions in duty. They have been, but

the analysis does mean that the reciprocal trade agreement program is entitled to very little credit for the increases in foreign trade that took place—so little credit, in fact, that it raises anew the criticisms that have been levied against the program, and suggests that the damage that is done to individual producing groups in the United States is far too great a price to pay for the infinitesimal gains that could be accredited to the reciprocal trade agreement program.”

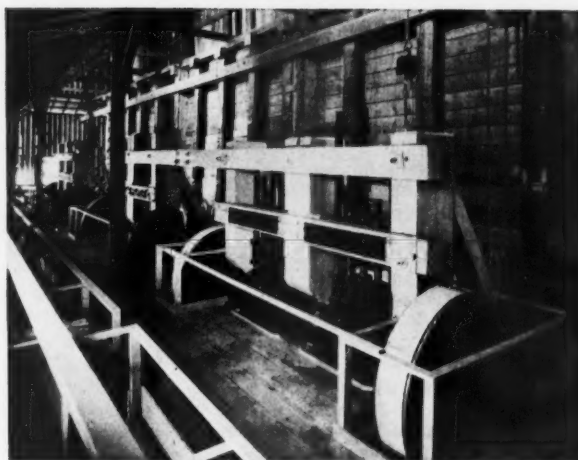
● ACCORDING to preliminary figures, the total mine production of gold in the United States (territories included) amounted to 3,596,991 fine ounces in 1935, which represented an increase of 485,171 fine ounces, or 16 percent, over the 1934 production of 3,111,820 fine ounces. Based on the average annual value of \$35 per ounce the 1935 production was worth \$125,894,685, which was \$17,136,626 or almost 16 percent greater than the 1934 value figure of \$108,758,059, based on the 1934 average value of \$34.95 per fine ounce. The increase in production for 1935 over 1933 was 40 percent in quantity and 92 percent in value, and for 1935 over 1932 the increase was 40 percent in quantity and 137 percent in value. The disparity between the quantity and value increases reflects, of course, the 69 percent increase in the value of gold (\$20.67+ to \$35 per fine ounce) that resulted from Government decrees and legislation between August 9, 1935, and January 31, 1934.

Of the total production in 1935 California contributed 24 percent; South

Dakota, 16 percent; Alaska, 13 percent; Philippine Islands, 12 percent; Colorado, 10 percent; Arizona, 6 percent; Utah, 5 percent; Nevada, 5 percent; and Montana, 4 percent. In 1934 California contributed 23 percent; South Dakota, 16 percent; Alaska, 17 percent; Philippine Islands, 11 percent; Colorado, 10 percent; Arizona, 5 percent; Utah, 4 percent; Nevada, 5 percent; and Montana, 3 percent.

This analysis of gold mining and the state reviews for 1935 that follow were summarized by Charles W. Henderson, of Denver, Colo., from current reports of the western field offices of the United States Bureau of Mines.

● TWENTY-SIX anthracite producers on February 12 participated in a conference with the Governor of Pennsylvania in an effort to eliminate the difficulties that have resulted from the “Stolen Coal” situation. The Governor refused state aid and said that he would not “use the state police unless requested by the local authorities.” Charles F. Huber, spokesman for the producers



Stamp Mill, Carson Hill Gold Mining Co.

presented to the Governor a review of the situation, saying, in part:

“An industry which supports Government by taxes aggregating over \$13,000,000 annually, is entitled to have its tax paying properties protected from organized robbery. Moreover, the public welfare demands that the state government should not set a precedent for the breakdown of law and order by openly countenancing a condition, which the attorney-general properly describes as a state of ‘anarchy.’ It is entirely appropriate, therefore, that this industry, restive under the continued inaction of public officers, should now ask the Governor of the state to intervene. Unless the state acts promptly the social and economic results of its failure to restore law and order will prove a veritable scandal to the commonwealth.

“It is no answer to this disgraceful situation to say that the men engaged in thievery must make a living, and, therefore, should be allowed to continue this state of anarchy until the anthracite industry will give them employment. ‘Thou shalt not steal’ is one of the cornerstones of civilization. It states a principle which cannot be compromised. As Honorable Louis D. Brandeis, now a Justice of the Supreme Court of the United States, once said:

“‘You may compromise a matter of wages; you may compromise a matter of hours . . . but you may not compromise on a question of morals or where there is lawlessness or even arbitrariness. Industrial liberty, like civil liberty, must rest upon the solid foundation of law. Disregard the law in either, however good your motives, and you have anarchy.’

“Entirely aside from the moral and legal aspects of the situation, it is only by increased market demand that additional employment will be made available in the industry. Those now employed and working little more than half time cannot be asked to share their work with the ‘bootleggers.’ Producers cannot employ additional men or open additional operations to produce more

MINE PRODUCTION OF GOLD IN THE UNITED STATES, BY STATES, 1935

| State or Territory        | 1934        | 1935        | Increase (+) or decrease (—) |          | Value                |                      |
|---------------------------|-------------|-------------|------------------------------|----------|----------------------|----------------------|
|                           | Fine ounces | Fine ounces | Fine ounces                  | Per cent | At \$34.95 per ounce | At \$35.00 per ounce |
| Western States and Alaska |             |             |                              |          |                      |                      |
| Alaska                    | *537,282    | *453,294    | — 83,988                     | —16      | \$18,778,000         | \$15,865,290         |
| Arizona                   | 167,024     | 226,500     | + 59,476                     | +36      | 5,837,493            | 7,927,500            |
| California                | 719,064     | 869,400     | +150,336                     | +21      | 25,131,284           | 30,429,000           |
| Colorado                  | 324,923     | 351,347     | + 26,424                     | + 8      | 11,356,070           | 12,297,145           |
| Idaho                     | 84,817      | 83,800      | — 1,017                      | — 1      | 2,964,361            | 2,933,000            |
| Montana                   | 97,446      | 147,850     | + 50,404                     | +52      | 3,405,736            | 5,174,750            |
| Nevada                    | 144,275     | 178,800     | + 34,525                     | +24      | 5,042,417            | 6,258,000            |
| New Mexico                | 27,307      | 35,560      | + 8,253                      | +23      | 954,380              | 1,174,600            |
| Oregon                    | 33,712      | 51,800      | + 18,088                     | +54      | 1,178,220            | 1,813,000            |
| South Dakota              | 486,119     | 563,952     | + 77,833                     | +16      | 16,989,858           | 19,738,320           |
| Texas                     | 359         | 622         | + 263                        | +73      | 12,538               | 21,770               |
| Utah                      | 136,582     | 184,950     | + 48,368                     | +35      | 4,773,524            | 6,473,250            |
| Washington                | 8,302       | 9,900       | + 1,598                      | +19      | 290,149              | 346,500              |
| Wyoming                   | 4,871       | 4,112       | — 759                        | —16      | 170,254              | 143,920              |
| Total                     | 2,772,083   | 3,159,887   | +387,804                     | +14      | \$96,884,284         | \$110,596,045        |
| Eastern States            |             |             |                              |          |                      |                      |
| Alabama                   | 2,781       | 2,262       | — 519                        | —19      | \$97,186             | \$79,170             |
| Georgia                   | 970         | 994         | + 24                         | + 2      | 33,898               | 34,790               |
| North Carolina            | 509         | 562         | + 53                         | +10      | 17,779               | 19,670               |
| Pennsylvania              | 623         | 600         | — 23                         | — 4      | 21,774               | 21,000               |
| South Carolina            | 642         | 1,065       | + 423                        | +66      | 22,439               | 37,275               |
| Tennessee                 | 455         | 425         | — 30                         | — 7      | 15,902               | 14,875               |
| Virginia                  | 667         | 477         | — 190                        | —28      | 23,315               | 16,695               |
| Total                     | 6,647       | 6,385       | — 262                        | — 4      | \$232,293            | \$223,475            |
| Central States            |             |             |                              |          |                      |                      |
| Michigan                  | 59          | ....        | — 59                         | ....     | \$2,049              | ....                 |
| Philippine Islands        | *332,974    | *430,655    | + 97,681                     | +29      | \$11,637,441         | \$15,072,925         |
| Puerto Rico               | 57          | 64          | + 7                          | +12      | 1,992                | 2,240                |
| Total                     | 333,031     | 430,719     | + 97,688                     | +29      | \$11,639,433         | \$15,075,165         |
| Grand total               | 3,111,820   | 3,596,991   | +485,171                     | +16      | \$108,758,059        | \$125,894,685        |

\* Refinery receipts.

coal until there is a market. The problem of unemployment in this and other industries similarly situated cannot be met by such means. The appropriation of funds from the public treasury for relief and public works constitutes a full recognition of that fact.

"Let it also be noted that in a large measure this organized lawlessness, while it may have started as something incidental to unemployment, has developed into a major 'racket' involving thousands of persons who were never employed in the industry; and thousands who, in addition to their income from stealing, are recipients of Federal relief.

"The operators before you today, fully alive to the gravity of the situation, have for a long time urged the state of Pennsylvania to perform its elementary function of maintaining law and order and protecting legitimate property rights and legitimate industry. For over a year law enforcing agencies, both local and state, have been fully advised of this state of anarchy, but have failed to perform their duty.

"Words fail to express our disappointment that the Governor of the state has refused to perform his duty in order to protect the industry and increase legitimate employment. For as long as the stealing of coal continues it will result in increasing unemployment of legitimate labor."

Among the producers at the conference were L. R. Close, president, Lehigh Valley Coal Company; Charles Dorrance, president, Penn Anthracite Collieries Company; C. A. Gibbons, general manager, Susquehanna Collieries Company; John Gilbert, president, Madeira, Hill & Co.; F. W. Leamy, senior vice president, The Hudson Coal Company; Donald Markle, president, Jeddo-Highland Coal Company; James H. Pierce, president, Scranton Coal Company; T. M. Dodson, vice president, Weston Dodson & Co.; H. M. Smyth, president, St. Clair Coal Company; Nat. D. Stevens, president, Stevens Coal Company; R. E. Taggart, president, Philadelphia & Reading Coal & Iron Co.; T. D. Lewis, general superintendent, Lehigh Navigation Coal Company; Frank Passarelli, president, Pompey Coal Company; Louis C. Madeira, III, executive director, Anthracite Institute, and Oscar F. Ostby, president, Independent Anthracite Coals, Inc.

Although no statement has been made as to the next step to be taken by the producers in their determination to bring to an end this high-handed robbery which today not only involves some 5,000,000 tons of coal annually, but also threatens the economic development of many coal properties, it is clear that further steps will be taken with or without help from Harrisburg.

● **REPORTS** and recommendations as to functions of the United States Bureau of Mines for the current year were made by committees of the advisory board to this Bureau at a meeting held in Washington, February 6. Approval of ac-



**Howard N. Eavenson**  
Chairman, Advisory Board to  
U. S. Bureau of Mines

complishments of the Bureau during the past year, as summarized by Dr. John W. Finch, director, was generally expressed.

Committees of the advisory board submitting reports were those appointed to study economics and statistics, explosives, coal mining and fuel investigations, mining and metallurgy, and petroleum and gas problems.

Especially emphasized was the Bureau's work in safety and prevention of mine accidents. Both coal and metal mining committees referred in strongest terms to the importance of this work and the need of carrying it on as vigorously as possible. Also advocated were extensions of the Bureau's work in the study of silicosis, in view of the wide interest in this subject and the many misunderstandings which are prevalent concerning it.

It was felt that the several mine experiment stations, located in various mining regions, are well located and doing good work, and that under present conditions all of them should be continued, but that no new stations should be considered until after very thorough and careful consideration. The committees especially recommended fundamental research in metallurgy and allied lines and a continuation of the Bureau's policy of avoiding duplication of research work carried on by private organizations.

Endorsement was given to the Bureau's economic studies of mineral production and distribution, conducted on a basis of voluntary cooperation as in the past. A survey of coal distribution from the various producing fields and a survey of crude oil in storage were particularly recommended.

Committees to be appointed for the coming year include those on safety and health, coal investigations, mining problems, industrial minerals, ferrous metallurgy, nonferrous metallurgy, petroleum and gas problems, and economics and statistics.

Members of the advisory board attending the meeting were: Howard N. Eavenson,



**Dr. John W. Finch**  
Director, U. S. Bureau of Mines

son, Pittsburgh, Pa., chairman of the board; W. R. Boyd, Jr., executive vice president, American Petroleum Institute; J. Thompson Brown, vice president, E. I. du Pont de Nemours & Company, Inc., Wilmington, Del.; E. W. Bullard, president, E. D. Bullard Company, San Francisco, Calif.; Galen H. Clevenger, U. S. Smelting, Refining & Mining Company, Boston, Mass.; Julian D. Conover, secretary, The American Mining Congress, and secretary of the advisory board, Washington, D. C.; John L. Coulter, secretary-treasurer, International Association of Oil Field, Gas Well and Refinery Workers of America, Washington, D. C.; J. D. Creveling, American Gas Association, New York, N. Y.; George H. Deike, Mine Safety Appliances Company, Pittsburgh, Pa.; H. C. Fremming, president, International Association of Oil Field, Gas Well and Refinery Workers of America, Washington, D. C.; D. S. Hanley, vice president, Pacific Coast Coal Company, Seattle, Wash.; Louis C. Madeira III, executive director, Anthracite Institute, New York, N. Y.; Frank Morrison, American Federation of Labor, Washington, D. C.; Charles F. Roeser, president, Independent Petroleum Association of America, Fort Worth, Tex.; James P. Williams, Jr., president, Koppers Coal & Transportation Company, Pittsburgh, Pa.

### —Personals—

**George C. McFadden**, Peabody Coal Company, who has been confined to a hospital since the middle of January, is reported improving slowly but satisfactorily.

**H. F. Hebley**, for many years associated with Allen & Garcia, Chicago firm of consulting engineers, has joined the Commercial Testing & Engineering Company. He will continue his work in coal preparation upon which subject he is an outstanding authority.



S. W. Blakslee

S. W. Blakslee, Philadelphia & Reading Coal & Iron Company, has accepted the chairmanship of the Committee on Arrangements for the Thirteenth Annual Coal Convention and Exposition of The American Mining Congress. Mr. Blakslee is serving with R. E. Salvati, Island Creek Coal Company, and E. J. Newbaker, the Berwind-White Coal Mining Company, chairman of the Coal Division and one of the Program Committee for this important event.

Those who were honored at the recent meeting of the A. I. M. & M. E., were Clinton H. Crane, president, St. Joseph Lead Company; C. C. Henning, assistant general metallurgist, Jones & Laughlin Steel Corp.; Francis Hearne Crockard, metallurgist, Republic Steel Corporation; Professor Robert Peele, professor emeritus of the School of Mines at Columbia University.

J. W. Patterson, mining engineer, has joined the staff of the American Smelting & Refining Company, at El Paso, Texas.

R. W. Higgins, of Duluth, who has been seriously ill, is reported as definitely improving.

Robert C. Adams, president, Bancameroca-Blair Corporation, which headed a group that acquired 250,000 shares of Lehigh Navigation Coal Co.'s capital stock, was elected to the board of managers at the annual meeting of the stockholders in February.

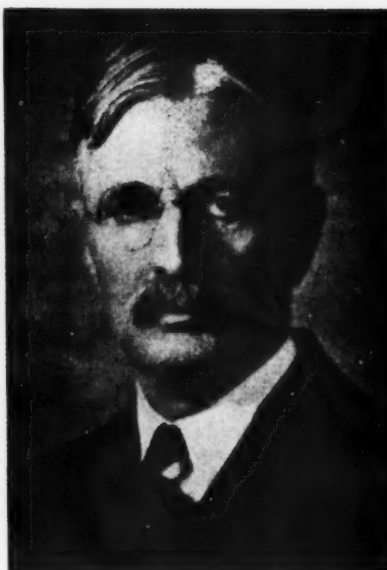
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Clinton H. Crane

Clinton H. Crane, president, St. Joseph Lead Company, was awarded the William Lawrence Saunders gold medal for "distinguished achievement in mining," "achievement in successful development and operation of low-grade lead mines," at the recent meeting of the American Institute of Mining and Metallurgical Engineers.

Gilbert L. Lacher, has resigned as managing editor of *The Iron Age* to become editor of the United States Steel Company's new publication, *United States Steel News*.

H. L. Hughes, vice president, United States Steel Corporation, has been elected treasurer of the American Iron and Steel Institute.

General Brice P. Disque, of Pattison & Bowns, Inc., formerly director of the Anthracite Institute, has been on a vacation trip in the South.

J. F. Calbreath, secretary emeritus, American Mining Congress, has been in Colorado on business connected with his large farming interests in the San Luis Valley.

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John G. Barry

John G. Barry, consulting mining geologist and engineer, of El Paso, Texas, has returned to El Paso following an extensive examination trip in Sonora and Sinaloa, Mexico.

Among recent visitors to the Washington headquarters of The American Mining Congress were Otto Herres, United States Fuel Company, Salt Lake City, Utah; R. C. Allen, Oglebay Norton & Company, Cleveland, Ohio; V. P. Geffine, Cleveland-Cliffs Iron Company, Cleveland, Ohio; H. C. Jackson, Pickands Mather & Company, Cleveland, Ohio; L. W. Shugg, General Electric Company, Schenectady, N. Y.; W. D. Turnbull, Westinghouse Electric & Mfg. Company, E. Pittsburgh, Pa.; and H. B. Cobban, Northeast Oklahoma Railroad Company, Miami, Okla.

#### Died

Frank A. Ross, E. M., died of chronic heart trouble, in Spokane, February 7, at his rooms in the University Club, age 76. He was with Marcus Daly in Montana, and was consulting engineer for Headley Gold Mining Company, at Headley, B. C., during its development. He was three times president of Northwest Mining Association.

J. E. Lee, general manager, the Sheridan-Wyoming Coal Company, Inc., was killed in an automobile accident on Tuesday, February 25, 1936.

R. J. Ireland, president of the Owl Creek Coal Company, died on February 20, 1936, at Amityville, N. Y., age 61 years. Mr. Ireland was a pioneer operator in northern Wyoming, having pioneered and developed what is now known as the famous Gebo seam in the Big Horn Basin in Wyoming. Operations were started there in 1906 and Mr. Ireland remained president of the company until his death.

# The Manufacturers Viewpoint

● THE CARNEGIE-ILLINOIS STEEL CORPORATION announces a further step in its sales activities through the consolidation of the Lorain Division district offices with the established district offices in Chicago, Philadelphia, New York, Cleveland, and Pittsburgh.

● A NEW DEVELOPMENT in valve design that promises to be of great importance to air and gas compressor users is the Channel Valve, recently announced by Ingersoll-Rand. In designing the Channel Valve, a greater-than-usual portion of the valve opening is utilized, which tends toward slower air speeds through the valve ports. A copy will be furnished on request by Ingersoll-Rand Co., 11 Broadway, New York City.

● THE LINDE AIR PRODUCTS COMPANY, New York, has available a booklet, "How to Bronze-Weld," summarizing the available information on bronze-welding and bronze-surfacing. This is a practical presentation of the fundamental theory and technique of bronze-welding and bronze-surfacing. The advantages of speed and economy are brought out, and also the ability of bronze-welding to accomplish jobs which otherwise might be difficult or impossible such as the joining of dissimilar metals.

● ANNOUNCEMENT is made by Link-Belt Company, Chicago, that the Feenaughty Machinery Company has been appointed distributor for Link-Belt shovels, cranes, draglines in Pacific Northwest territory. Feenaughty headquarters are in Portland, Oreg., with branches located in Seattle and Spokane, Wash., and Boise, Idaho. The organ-

ization is headed by W. O. Feenaughty, president; J. I. Overman, vice president; D. J. Feenaughty, secretary; and F. A. Kingston, sales manager.

● NEW and revised requirements for most of the rotating electrical machinery manufactured and used in the United States are now made available in a single volume, the *American Standards for Rotating Electrical Machinery*, just published by the American Standards Association. Standard requirements and specifications for electrical machinery, from the large central station generators and industrial and steel-mill motors to the small motors used on household appliances, such as vacuum cleaners and electric fans, are included in the new publication. Direct-current, synchronous, and induction machines, synchronous converters, and a-c and d-c fractional horsepower motors are covered.

● THE NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION has just released Publication 36-31, entitled "NEMA Rubber Insulated Building Wire and Cable Standards, National Electrical Code Grade Compound." This is to be followed shortly by publications covering 30 percent grade compound and performance grade compound. This pamphlet contains the NEMA standards for the complete wire or cable which includes the conductor, insulation, fibrous covering and lead sheath. Such items as physical properties and methods of test, insulation thicknesses, insulation test voltages, saturation of braid, etc., can be readily determined by referring to the standards in this publication.

Copies of this 16 page, 8x10½-inch pamphlet may be obtained from the National Electrical Manufacturers Association, 155 East 44th Street, New York City, at 25 cents per copy.



Karl H. Runkle

● J. D. WRIGHT and KARL H. RUNKLE were appointed assistant managers of the General Electric Company's industrial department, effective February 24, according to a recent announcement made by J. E. N. Hume, manager of the department. Prior to their promotions, Mr. Wright was assistant head of the industrial department's engineering staff and Mr. Runkle was manager of sales of the department's mining and steel mill section. Both entered General Electric employ as student engineers on the "test" course shortly after their graduation from college.

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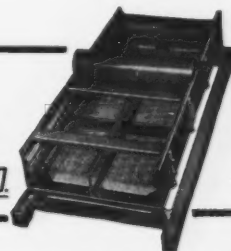
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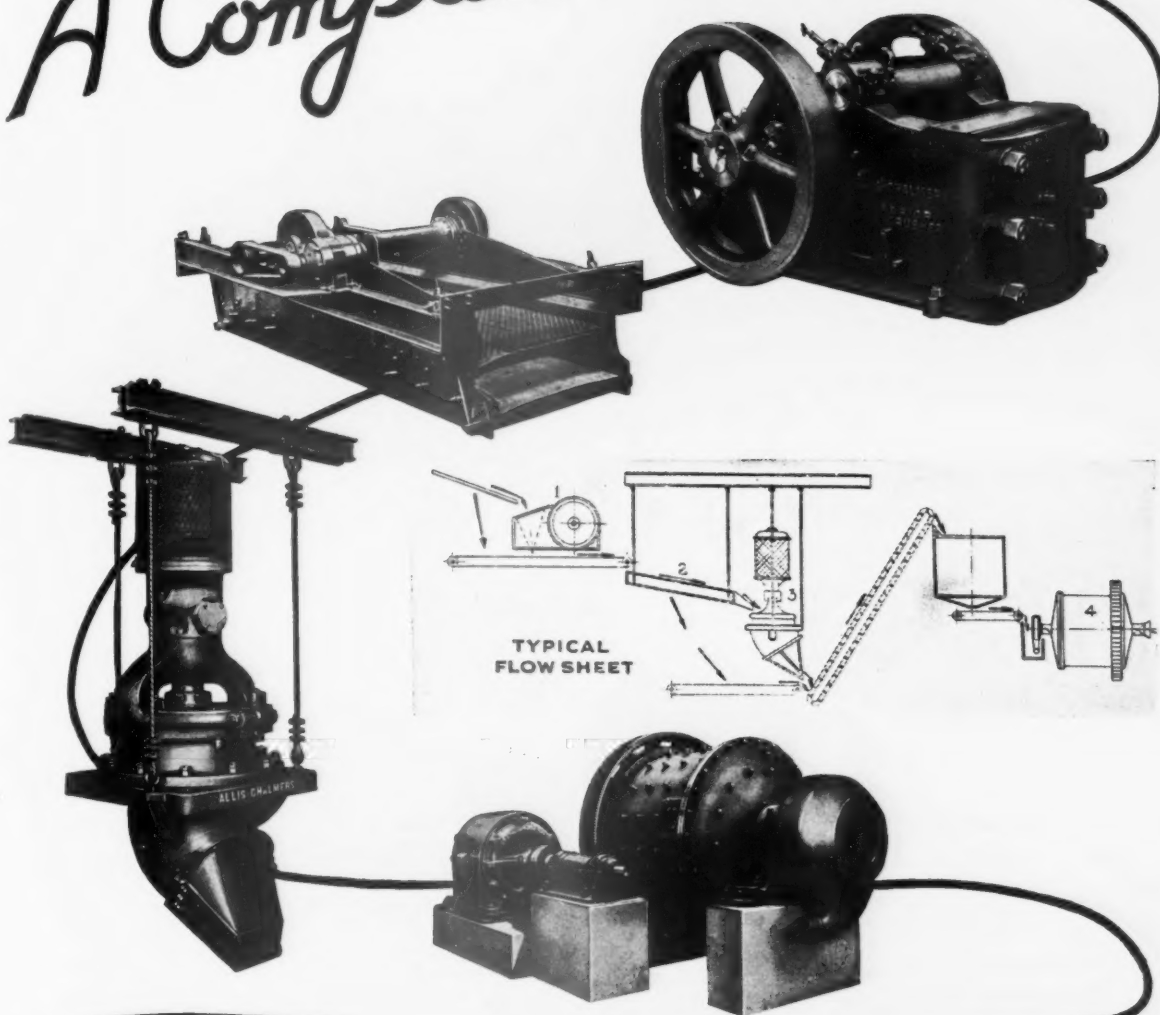
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